Teaching with perspective

A generative toolkit for permanent expansion of your teaching skills

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Any teacher will enjoy looking back on his own lessons in which pupils were challenged and outdid themselves. In such challenging classes students do not only learn a lot from you, but more often than not, you also learn something new about teaching. You probably tried something new, which apparently worked out well. This brochure provides you with a practical toolkit to enhance your teaching repertoire of lessons with differentiated challenges almost endlessly. It is a process of building on what you already know and are able to do, so you stay in flow, and loss of control and boredom are both avoided. Characteristic of this approach is that the elements of your regular lessons form the basis of every gradual innovation. We will show you how to make any class challenging and differentiated quickly and easily by reversing and selectively omitting existing elements of your lessons. This toolkit is introduced and illustrated in this brochure with examples from different school subjects. In the Appendix – which you may wish to start with – you will find additional examples for most subjects in primary as well as secondary education. The design of this brochure is as follows:

1. There are many ways leading to Rome: as there are many ways of teaching.
2. Developing your teaching repertoire: the gold standard.
3. On the nature of generative toolkits: what are the similarities between LEGO, DNA, MINECRAFT, CHESS and LANGUAGE?
4. Using the toolkit for teaching: providing differently challenging education by reversing and omitting existing lesson elements.
5. Justification of the building blocks and rules of the generative toolkit.
6. Schemes and practical tips for designing whole tasks and adaptive support.
7. Two building block expansion sets: educational theories and subject theories.
8. How to use the generative toolkit for shaping your own learning trajectory?

Appendix with detailed lesson ideas for respectively:

Language, Numeracy, World Orientation, Modern Foreign Languages, Dutch, Greek and Latin Language and Culture, Philosophy, History, General Economics, Management & Organisation, Sociology, Geography, Chemistry, Biology, Physics and Mathematics.

1. There are many ways leading to Rome: as there are many ways of teaching

Every topic from your school subject can be taught well in a hundred different ways. As an example, you will find below five short descriptions of the same topic, for the same target audience. The lessons have in common that they are all based on a limited number of principles of good teaching. These principles take on a very different shape in every lesson however. In every class, the topic is approached from a different angle or perspective, so different aspects of the subject turn up, and students also learn more than just the core curriculum. Moreover, there is a change in the roles of students and teacher in the process of teaching and learning.

This example shows that the question "What is the best way to deal with subject x?" is not the right one, and should be replaced by the question "How can you continue to expand your teaching repertoire, so that you can teach your subject in many different ways, and a little differently every time?"

Having a wide spectrum of teaching skills at your disposal comes with a number of important advantages for you as a teacher:

- Your expertise is constantly enriched as you or your pupils approach topics from a different angle every time.
- You learn a lot from your pupils when you change your approach regularly.
- You are better able to put your own educational ideals into practice.
- You are better at responding to differences between pupils and doing right by them.
- Changes in your subject become easier to manage and play around with.

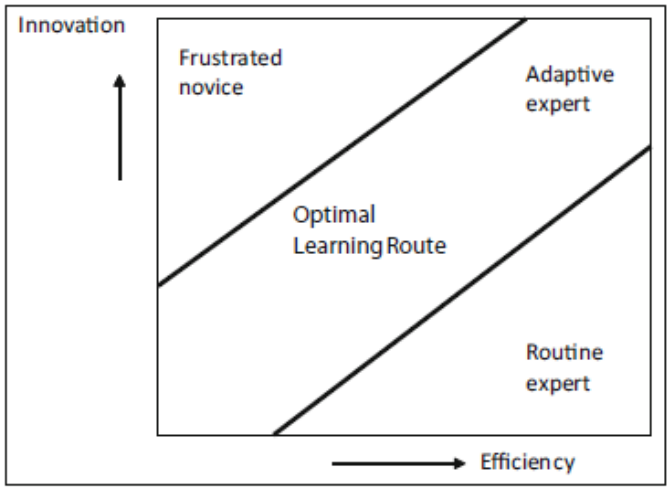
In conclusion: by continuously expanding your teaching repertoire, you can get more out of yourself, your pupils and your subject. Of course this raises the question of what is the best way to develop your repertoire.

Lesson about the three layers of the skin for a first-year class: five times differently

How deep do you have to stick a needle to have a lifelong tattoo? The teacher shows a photo of a tattoo and asks to consider this question for two minutes. Pupils can subsequently choose between the options of either first hearing the explanation of the skin layers and then answering the question, or starting by trying to answer the question by using the textbook. For this, the question is stated in more detail. Pupils are asked to not only state in which layer to stick, but also, why there and what would happen if ink was injected into the other two layers. The assignment is discussed in the classroom afterwards.	
Where is your skin most sensitive? Two wooden skewers are handed to one pupil, the other one is the guinea pig. They investigate which parts of the skin are more sensitive. They write down what the smallest distance is in different places at which each skewer can still be identified separately. Then the teacher briefly explains the three layers of the skin. After this, the pupils are instructed to find out in which layer the sense of touch is located, why there, and what the effect would be if it was located in any other of the two layers.	
How can you make skin from a plastic bag? The teacher holds a plastic bag and asks the pupils what the possible disadvantages could be if you did not have skin, but instead, a plastic bag, and how you could overcome this disadvantage. For example: it would be pretty sweaty. Solution: holes (teacher punctures the bag,) resulting in another disadvantage: dirt may enter. Solution: selective passage (as happens by our skin's pores.) The teacher relates for each solution whether this actually happens in our skin, at which layer, and why exactly.	
Your own skin: Case study Pupils can choose their own case study of something that they feel concerns the layers of the skin. For instance, a girl chooses moisturizing cream. The teacher now explains every layer of the skin, and subsequently, the pupils have to apply all terms discussed to their case studies.	
Playing doctor Groups of pupils are assigned various skin diseases, for which they have to find out on the Internet what is wrong in which layer of the skin, what the symptoms are and what can be done about it. Then there is roleplay of the pupils in different groups: playing doctor, where the pupil with the information acts as the patient, and the other has to find out what is ailing the patient.	

2. Developing your teaching repertoire: the gold standard.

Developing your teaching repertoire has two dimensions. One the one hand, being able to employ your existing knowledge and skills more efficiently day by day is essential for teaching well. In other words, you develop efficient routines. Using routines enables you to act quickly and effectively while freeing up energy and power of thought to invest in the other dimension: renewing the repertoire. It is vital to strike a good balance between the two dimensions of developing your repertoire. One-sided attention to renewal without building strong routines will only result in frustration and a constant sense of not being in control of the situation. On the other, just aiming at building routines is not very satisfactory either. Not only does the repertoire remain very limited, teaching also becomes dull and boring this way. A gold standard offered for the development of repertoire is therefore balancing the two dimensions: teachers expand their repertoires step by step, building on their existing routines. A learning path such as this results in teachers with so-called adaptive teaching expertise. Those teachers have wide repertoires, and are able to realise their own (changing) ideals as well as the changing demands of the situation. Moreover, teachers who follow such a learning path will often experience *flow* in their work. In such circumstances you are completely engrossed in your work, and time flies by unnoticed. You experience *flow* when you do things that are pretty demanding, and you feel that you actually succeed, as opposed to situations in which you do not feel challenged (boredom) or in which more is demanded of you than you can handle (frustration/loss of control.) In a scheme below this looks as follows.



Developing repertoire as a balance between renewal and building routines

Renewing step by step, building on what you want and what you already know, is not easy to do. For how can you discover new options which are still based on existing routines?

3. On the nature of generative toolkits: what are the similarities between LEGO, DNA, MINECRAFT, CHESS and LANGUAGE?

There is a way of renewal or innovation which everyone is actually familiar with in other fields. What LEGO and language have in common is that you can innovate by recombining previously existing building blocks. You have a limited set of building blocks and rules. The building blocks can be used in endless new combinations. The rules determine which combinations are acceptable and which are not. Such a system can be labelled with the term *generative toolkit*, exactly because an enormous diversity in innovations or creations can be generated with a limited set of building blocks and rules.

Let us have a quick look at language. Its building blocks are located in the lexicon and exist of words and phrases. Syntactic rules are used to form correct sentences. The common sentence 'Dog bites man.' and the more newsworthy 'Man bites dog.' consist of the exact same elements, but by changing the order, the meaning is completely different. The diversity of utterances which can be generated by a limited set of building blocks and rules is boundless.

The language example also illustrates the fact that building blocks can differ in two dimensions: size and abstraction. Language building blocks come in different sizes, from letters to words to complete phrases like 'a director's director.' This particular phrase is also an example of a building block that is completely concretely specified. The expression shares its structure with similar phrases, such as 'an author's author': [(*a)* Noun *x*– *genitive* –Noun *x*], which means that the person the second Noun refers to is much admired by his peers. Such a more abstract characterization of the building blocks like this renders the advantage of in turn producing a whole lot of new concrete building blocks of the same type.

After this brief introduction into the nature of generative toolkits we can go on to characterizing our generative toolbox for teaching. It comprises two parts:

- Building blocks, which can be recombined into lessons.
- Rules increasing the chance of productive combinations, i.e. good teaching.

As with LEGO, a distinction can be made between the plain basic set of building blocks, and various expansion sets. The basic set holds only four building blocks.

In sections 4, 5 and 6 we will introduce the basic set and demonstrate the wide possibilities of the two simple rules. In section 7 two important expansion sets are introduced, and section 8 illustrates how you can extend your teaching repertoire even further with those.

A generative toolkit for teaching, consisting of four building blocks and two rules

Building blocks	Rules
• Instruction • Worked-out example • Whole task • Part task	• Whole task first (by reversal) • Adaptive support (by selective omission)

4. Using the toolkit for teaching: providing differentiated and challenging education by reversing and omitting existing lesson elements.

Most teachers will recognize the four building blocks from the basic set in his or her teaching. The four building blocks and the two rules are described in short below, and illustrated by a lesson example centred on development of knowledge, and in contrast, one that is centred on development of skills. It is followed by a short explanation of the two rules (whole task first by reversal and adaptive support by omission.) We would like to refer you to the Appendix for many more examples of reversal and omission for various school subjects.

Building blocks of the generative toolkit for teaching: basic set

Building block	**General description**	**Example 1**	**Example 2**
Instruction	The curriculum is presented in general terms.	The teacher explains the structure of the ear and how it works.	The teacher describes the procedure for summarizing a text.
Worked-out example	The curriculum is illustrated or demonstrated by an example.	The teacher describes what happens in your brain and ears when you experience 'ringing in the ears' after having listened to loud music.	The teacher shows, while thinking out loud, how to summarize a text on the basis of a concrete text.
Whole task	An assignment challenging pupils to use the core of the curriculum in a new situation.	Vincent van Gogh cut off his auricle. Pupils are asked if his hearing is better or worse and how this can be explained with the help of knowledge about the structure of the ear and how it works.	Pupils are given the task to summarize a text about the use of consonants and vowels in different languages.
Part task	An assignment demanding pupils to reproduce or apply a small part of the curriculum.	Pupils are asked to explain the nature of the hammer, anvil and stirrup, and what would happen if the stirrup was missing.	Pupils are given the task to underscore signal words in the text. They are also asked to underscore the core sentence of every paragraph.

Rules of the generative toolkit for teaching

Rule	**General description**
Whole task first by reversal	Start the introduction of new subject matter by introducing the whole task. Usually, an existing whole task can be brought forward to this end (reversal.)
Adaptive support help by selective omission	Consider everything you normally offer and do in class as help for doing the whole task. Give each pupil only the help that they require (selective omission.)

Example 1- Biology: A lesson about the ear

Before
The teacher first explains the new subject material about the structure of the ear and how it works. Then the pupils start their part tasks associated with the subject. In conclusion of the class, the teacher brings up the example of the 'ringing ears' and he asks his students whether Vincent van Gogh would hear better or worse after having cut off his auricle.
After reversal and omission
Whole task first The teacher starts his lesson on the ear by introducing Vincent and his cut-off auricle and invites his pupils to discuss for two minutes if his hearing is better or worse, and why? *Adaptive support* After the introduction of Vincent, pupils have a choice. They can either start with this task immediately, with just the ear diagram from the textbook to help them, using all terms mentioned in the diagram in their answers to the question. Or they can listen to the teacher's explanation about the structure of the ear before tackling the Vincent assignment.

Example 2 – Language: A lesson about summarizing

Before
The teacher explains the procedure for summarizing a text. The teacher presents, while thinking out loud, how to summarize a text on the basis of a concrete text. Then the pupils have to answer the questions that come with the text about vowels and consonants. These questions prepare them for the actual summary of the text.
After reversal and omission
Whole task first The teacher introduces the text which the pupils will summarize with the caption of the article*: Y cn rd wtht vwls bt t s slwr*. The puplis have to guess what is written here. The teacher supplements where necessary, thus introducing the subject of the article. Then the pupils are asked to summarize the text in 150 words**.** *Adaptive support* After this, pupils have a choice. They can either start with this task immediately, or first listen to an explanation and a detailed example from the teacher. The teacher shows, while thinking out loud, how to summarize text on the basis of a different text and explains the steps. Pupils who still experience difficulties get to do two or more part tasks with the text: finding signal words in the text and formulating the core of every paragraph in one sentence.

Example 3 - English: a presentation about the weather

Before

In a foreign language class with 'the weather' as a theme, the teacher first explains a grammatical rule. Then the pupils start working individually on the assignment from the textbook. Besides grammatical exercises it includes exercises through which the pupils can expand their vocabulary on the weather, and learn to form sentences about the weather, for instance by filling a news script ('Hello my name is… reporting for … et cetera'.) The workbook concludes with an assignment where the students are invited to present the weather in the foreign language. This assignment is skipped however because of the time limit.

After reversal and omission

Whole task first

The teacher shows an example of an English weather report. Following this example he introduces the whole task which the pupils will prepare in groups of four: present tomorrow's weather in English. Pupils who are in for a bigger challenge can expand their presentation by interviewing a passer-by about the weather.

Adaptive support

The teacher has selected six part tasks from the exercise book and copied those onto an A4 sheet. This sheet includes for example some exercises with words about the weather, the news script and two grammatical exercises. The pupils will start preparing a short presentation about the weather, and if they get stuck they can do one or more of the part tasks. It turns out that some pupils will do the part tasks first, and then start preparing for their presentation, where others start immediately with interviewing each other, looking at a part task only when they cannot find the right words in English.

Whole task first by reversal

Many regular classes start with an explanation of the subject matter, which may or may not be based on a detailed example, and after that, the pupils are assigned part tasks to practice with parts of the subject matter. If pupils ever get to work on a whole task, where the greater part of the subject matter has to be applied to a new situation, then this task is generally not offered before the end of the lesson or series of lessons. The 'whole task first' rule invites you to reverse this order, and start classes with the introduction of the whole task. Starting to teach about a new subject with the introduction of a whole task has a great deal of advantages, for the pupils as well as for the teacher.

Advantages of 'whole task first' for pupils

- Pupils are internally motivated towards the coming material: it is as if your learning targets become the pupil's question.
- A whole task invites pupils to activate relevant previous knowledge and skills, in order to be able to build on these.
- The task serves as a construction of a mental hat rack, lending meaning to specific knowledge, partial skills and part tasks.
- Pupils know from the very beginning for sure what they are supposed to know and be able to do at the end of the course: they have to be able to execute the whole task adequately.
- Pupils also exercise in class for what is expected of them in the end.
- Pupils are quick to discover what they do not know or cannot do, and therefore, what they still have to learn.
- Starting with the usually more complex whole task causes the lessons to be challenging from the start, also for pupils who have more potential.

Advantages of 'whole task first' for teachers

- By placing the whole task at centre stage, you are more engaged in the core of your subject. Pupils are expected to be engaged in an integrated way in important knowledge and skills in case of whole tasks.
- Pupils working on a whole task show more of themselves than when they just work on minor part tasks. So you learn a lot more about your pupils.
- On introduction of the whole task al already get an inkling of what the pupils already know, and you gain more insight as the work on the whole task progresses. This insight enables you to adapt your explanation or other kind of help to what the pupils need.
- Pupils are generally more motivated when they are working on a whole task, and that simply makes teaching more fun.

This whole task first principle is not entirely new. It is at the basis of almost any modern teaching approach, from mainly pupil-based teaching, such as problem-based teaching, competence-based teaching, guided discovery learning, to more teacher-based teaching such as task-oriented direct instruction and the master/apprentice approach. What is new is the way in which you as a teacher arrive at the whole task. Usually, complex time-consuming and labour-intense procedures are suggested to this end, designing the whole task 'from scratch.' In our

approach on the other hand, we demonstrate that such tasks already tend to prevail in education, and that you can cleverly use them by simply drawing them forward.

Adaptive support by selective omission

Of course most pupils are not able right at the beginning of a course to fulfil such a whole task successfully and independently. They need help to do this. Ideally, this help would be offered in his or her zone of proximal development. This means that pupils are helped to be successful at the task they would not be able to do without help, with just enough help, not too much, not too little. It is a fact that not all pupils in a classroom need the same amount of help for fulfilling whole tasks. For one pupil, a small hint will suffice, while the next pupil may need proper explanation from the teacher, or more exercise in part tasks before he can do the whole task. Compare this to many regular classes, where lessons are often not started with the introduction of a whole task, and pupils are all offered the exact same help; they are supposed to listen to the teacher's explanation together and do a large number of part tasks; only afterwards is there some room for enriching or compacting.

Now the notion of 'adaptive support' is not new either. It has been propagated under the name 'scaffolding' for years now in educational research. They never tell you though how a teacher can offer differentiated help in a classroom of 25-30 pupils in a practical way. We developed a simple and time-saving procedure with which you develop and offer adaptive support by selectively omitting existing help. Its starting point is that you consider everything you normally do in your classes (explanation, examples and part tasks) as help for doing the whole task. The pupils only have to do these existing parts of the curriculum if they need them to successfully finish the whole task. Such a form of challenging pupils differently by adaptive support through omission has a number of important advantages for the pupils as well as for the teacher.

Advantages for pupils:

- The pupil only has to do what is really needed to fulfil the whole task.
- The pupil can partly adjust the level of the classes himself, time and time again, and adapt this to what he wants to do and can do.
- The pupil works on a particular task with fellow pupils; they do not get extra tasks, but they can determine the complexity of the task.
- This way, the pupil determines to an important measure the way in which you set about your class.
- Pupils who can, and wish to do more, can immediately start working at their own level.
- In this setup, the teacher usually has more time available for pupils who need extra help.

Advantages for teachers:

- You do not have to prepare completely different assignments in order to differentiate for different pupils.
- Pupils are usually more motivated and more get-at-able about their behaviour when they have freedom of choice of how to tackle the assignment.

- You now only explain to willing pupils.
- You have more time to support weaker pupils.
- This way you discover what pupils actually can do on their own, which is usually more than they exhibit in regular lessons.
- Although you can cover the compulsory material in the same time span, you can be more creative with your textbook: you do not have to do it front-to-back.
- The changing roles of yourself and the textbook (from leading, to resource) will take some getting used to, but people generally like the experience.

'Whole task first' and 'Adaptive support' from simple to complex

The two rules of our generative toolkit can be detailed by the teacher to different levels of complexity. The lesson examples we just showed are relatively simple in design. The teacher determines the whole task, this task is about a limited amount of subject matter and the options concerning help are also limited.

However, the two rules and four building blocks can also produce more complex forms of teaching which is differentiated in challenge, as shown concisely in the rubric below. In the more complex forms, more of the subject matter is covered by the whole task, pupils have more say in determining the whole task they are working on, and the help is more personalized.

Differentiated challenging teaching from simple to complex

	Aspect	Simple → Complex		
Whole task first	**Nature of the task**	One perspective dominates	Plural perspectives	(Almost) All perspectives
	Size of task	Subject material for 1 class	Subject material for a series of classes	+ Fitting into the curriculum guideline
	Who designs the task?	Textbook	Teacher	Pupils & Teacher
	Differentiation of tasks	None	Several options	Personalized
	Product	Simple	Simple / Co-operative	Complex / Co-operative
Adaptive support	**Nature of help**	Content	Strategic	+ Motivational
	Size of help	A lot	Limited	Very limited
	Who decides on the help?	Teacher	Teacher & Pupil	Pupil
	Differentiation in help	Very limited	Various possibilities	Personalized help
	Resources	Textbook	Textbook and some other resources	Mainly other sources of information

Of course, any specific (series of) lesson(s) does not need to be either simple or complex, but teaching in one dimension may differ in complexity from another. We will illustrate this by means of a brief description of a series of lessons about the heart and circulatory system, where of course the teacher has determined the compulsory material, but pupils get to decide on their actual whole tasks.

Biology: heart and circulatory system with pupils formulating the whole task themselves

Before
First the teacher explains the new subject matter about the heart and circulatory system, then the pupils start working on the assignments in the book.
After reversal and omission
Whole task first The teacher hands the pupils a small list of all the terms they have to know by the end of the course (with notions like the left and right atriums, left and right ventricles, inferior vena cava, capillaries et cetera.) Then the pupils are invited to think of a situation (case study) concerning the build and operation of the heart and circulatory system. One pupil is into martial arts and chooses 'a fight' as an example, wanting to know what happens to your heart and circulatory system during and after a fight. *Adaptive support* The teacher starts every class by explaining the subject matter like he was used to doing, he only shortens his explanation a little. Then the pupils are assigned to apply the new information to their situations. The worksheet below for example shows the pupil who chose the fight applying the new material about coagulation to his case study.

Typing of the biology class

	Aspect	Simple → Complex		
Whole task first	**Nature of the task**	One perspective dominates	Plural perspectives	(Almost) All perspectives
	Size of task	Subject material for 1 class	Subject material for a series of classes	+ Fitting into the curriculum guideline
	Who designs the task?	Textbook	Teacher	Pupils & Teacher
	Differentiation of tasks	None	Several options	Personalized
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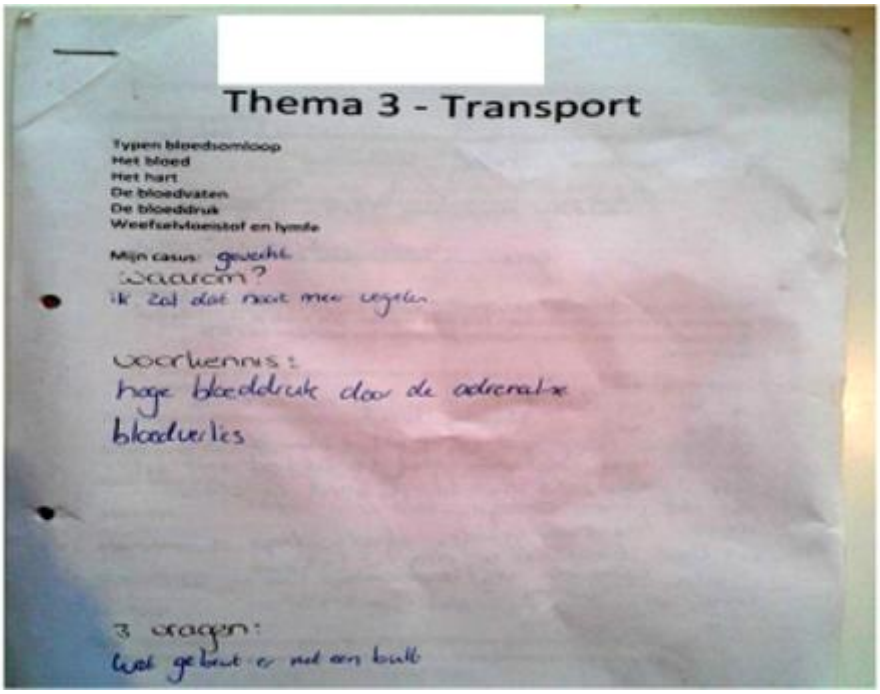
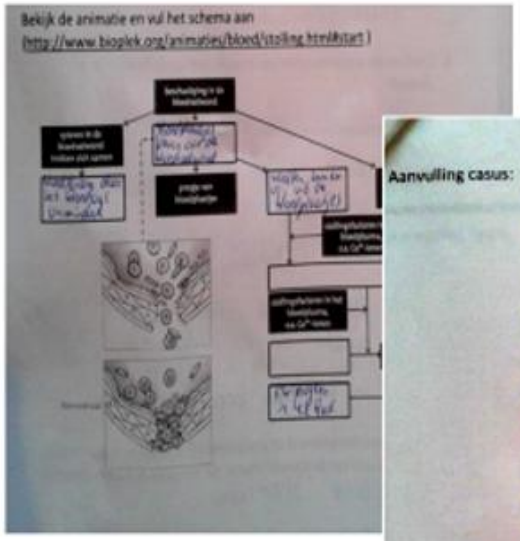
	Resources	Textbook	Textbook and some other resources	Mainly other sources of information

Worksheets of pupil applying the subject material to his self-formulated whole task





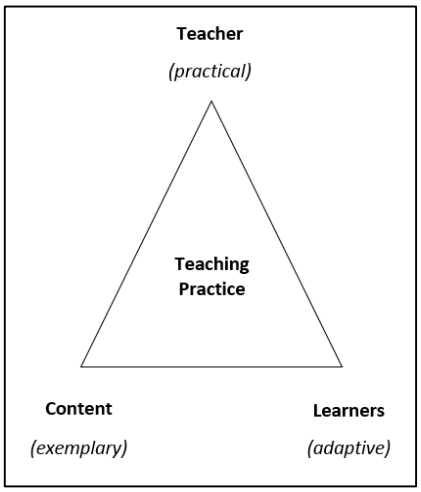
Aanvulling casus: bloedplaatjes gingen stollen op sneetjes die ik had om het bloed te laten doorstromen en dat het niet uitloopt dus ik had nog steeds 5 tot 6 liter bloed in mij. de bloedplaatjes probeerden zo veel mogelijk het bloed verlies tegen te gaan wat ook goed was gelukt

55 % van het bloed is bloedplasma witte bloed cellen worden ook wel leukocyten genoemd. Witte bloedcellen hadden niet echt een functie gehad bij mijn casus

Rode bloedcellen (erytrocyten) nemen steeds zuurstof op en aan weefsels af te geven, ik had veel meer zuurstof nodig dan normaal dus ze deden meer hun best

5. Justification of the building blocks and rules of the generative toolkit.

We introduced and illustrated the basic building blocks and rules of the toolkit for teaching. However, we have not really justified yet why classes made with these tools are good teaching. Good teaching is where the three corners of the didactic triangle (teacher, pupil and content, or: curriculum) are tuned to each other. In short: in good teaching, pupils acquire *valuable* content, in a manner that builds on what a pupil knows and can do (*adaptive*) and which is *practical* for the teacher.



In good teaching, the three corners of the didactic triangle are tuned to each other

This may seem self-evident, but many proposed educational reforms fail in one or more of the cornerstones of good teaching. For instance, there are many proposals where the learnability was not researched. Proposals that have empirically proven to be learnable can hardly be executed by teachers in practice in classrooms of 25-30 pupils, with barely any preparation time per class and a packed curriculum. Finally, too many teaching proposals are derived from general theories about education and learning, with not enough regard for the specific nature of the subject. In which case, the curriculum is learnable, but not necessarily valuable to learn.

Below, we will briefly state why the building blocks and rules of our generative toolkit result in teaching which is practically executable for the teacher, potentially learnable for the pupils and valuable with respect to the essence of the school subject.

Practical for the teacher

Implementation research shows again and again that most proposals for educational reforms (differentiation, open inquiry et cetera) hardly impact the practice of teaching - if at all. Are teachers so stubborn or is something else the matter? We genuinely think something else is the matter. We can illustrate this by the impossible teapot by artist Jacques Carelman. This teapot has a perfect little

nozzle to pour tea with, but this pot will never be used because the handle is on the wrong side. Many educational proposals are similar to the impossible teapot: they are optimized for their primary purpose (promoting pupils' learning) but are not suited to the user (the teacher.) Any proposal that is considered practical by teachers meets the three criteria below.

Criteria teachers use to look at the practical usability of an educational renewal proposal

Criterion	Description
Instrumental	A teacher knows how to convert the teaching ideology into activities and action. In other words, just a blueprint won't do, a teacher needs to have procedures at his disposal to actually realize the blueprint in class.
Low cost	The teacher needs to be able to execute the proposal with little extra time and means. In other words, the teacher needs to have time and labour-saving procedures at his disposal (such efficient procedures are sometimes called 'heuristics'.)
Congruency	The proposal provides adequate realization of the other teacher targets at the same time. In other words: promoting pupils' learning is just one of the teacher's concerns. At the same time, he/she has to motivate the pupils, get and keep order in class, finish the curriculum in time, attend to every pupil and look at every pupil's work.

We tried to make the toolkit as practical as possible to use in the following ways:

- With the toolkit you do not design 'from scratch'; you depart from existing elements of your lessons (low cost.)
- By using the two simple and time-saving procedures (heuristics,) of reversal and omission of existing elements of your lesson, you can convert your teaching into teaching which is more differentiated in challenge (instrumental + low cost.)
- Starting point is the curriculum of the regular classes, which means that the whole tasks cover the full curriculum (low cost.)
- The subject material can basically be dealt with in the same time by the whole task first and the adaptive support approach (low cost.)
- Whole task first as well as adaptive support can be shaped in very many different ways. At every point, you as a teacher get to decide on the way that fits your abilities, wishes and bravery at that very moment (congruency.)
- Teaching whole task first and adaptive support the way we masterminded it does not only promote the pupils' learning, it also results in the simultaneous realization of a number of other targets, such as motivating pupils, getting and keeping order, keeping everybody busy et cetera – and often with more ease (congruency.)

Adaptivity for the pupil

Teaching should not only be practically doable for the teacher; of course it should also promote the pupils' learning. A lot of research has been done into what constitutes learnable teaching. This has resulted in long lists of criteria, where it is often unclear how these criteria are related. Below, we tried to show the most important criteria in such a way that their logical interdependence is clarified.

Criteria of adaptivity

	Criteria		
Opportunity	**Purposeful**	Were you able to practice what you have to be able to do?	
	Clarity	Did you know what was expected of you?	
Wanting	**Interest**	Did you think it was interesting?	
	Expectation of success	Did you think you would be able to do it?	
Being able	**Challenging**	Was it too easy, or too hard for you?	
	Adaptive support	Did you get the help you needed (not too much or too little?)	
Trust	**Respect, care, understanding**	Did you feel taken seriously?	
	Autonomy	Did you have freedom of choice? Did you feel in control?	

A pupil only learns effectively when he/she is given the opportunity, wants to, is able to and when there is a certain sense of mutual trust. Two criteria can be identified for each of these main categories. We formulated them as questions a pupil should be able to answer affirmatively after having followed the education concerned. From the perspective of adaptivity for individual pupils, teaching was optimal if all pupils were to answer all questions in the affirmative. Of course this ideal is hard to realize, but if you have your pupils fill out a questionnaire like this every now and then, it will give you a reasonable impression of how much you succeeded as a teacher in differentiated challenging in your classes. Below, we briefly discuss the criteria and we indicate how we intend to contribute positively to realizing the criterion concerned for every pupil through whole task first and adaptive support.

Learning postulates in the first place that the learner is given the opportunity to do so. This seems self-evident, but it is not always the case. To begin with, a pupil has to practice activities which he/she actually does have to learn (*purposeful.*) By placing whole tasks at the centre, the pupil already starts exercising what is expected of him/her, which is, being able to use the knowledge and skills productively in new situations. Besides that, a learner also has to know what he/she has to do, what is expected of him/her in order to reach the intended learning goals (*clarity*.) A whole task may be seen as a very specific formulation of what exactly is expected of pupils by the end of the course: the pupil minimally has to be able to fulfil this task adequately.

Giving the opportunity is not nearly enough: the learner also has to be motivated to learn anything. Two factors determine intrinsic motivation. One the one hand, the pupil has to find the task interesting (*interest.*) On the other, the learner has to have a feeling that he/she is able to do the task successfully (*expectation of success*.) Placing the whole task at the beginning of the process of teaching and learning is particularly suited for intrinsically motivating pupils for the subject material. With adaptive support, the pupil will develop confidence that he or she will be able to complete the task successfully.

Just being willing is not sufficient either. The task needs to be exactly challenging, neither too easy nor too difficult. The help also needs to be just right; too much help is as counterproductive

as too little help. By means of formulating the task and help for each pupil, the task and help is tuned to what a pupil is able to do.

But even if the learner gets the opportunity, is willing and able, success is not guaranteed. For learning usually takes place in a social setting; the learner's social context may invigorate him, but it may also render him/her potentially vulnerable. That is why proper learning can only take place when the learner is fairly confident about himself and his/her environment. Confidence in turn is felt when the learner feels he is *respected, understood and supported* (in other words: taken seriously) by himself and others, in particular by the teacher, and when he/she also experiences a certain sense of control over his own learning process *(autonomy.)* Offering choices in formulating tasks and help as well as offering adaptive support is conducive to developing mutual understanding between teacher and pupil. Moreover, this type of teaching provides the teacher with more knowledge about his pupils, about their interests and possibilities as well as about their learning needs, which is certainly conducive to pupils feeling more and more taken seriously.

Valuable content

Teaching that is practical to use and learnable for the pupil is still not necessarily good. After all, teaching is only worthwhile if the pupils gain access to the prevailing insights and current views and practices of the school subject. These fundamental thoughts, views and practices are what enable the pupils to deal with future new situations and to go on studying more easily later on. Those thoughts and views and practices should therefore reflect the essence of the school subject.

Whole tasks are often concrete situations on the basis of which more abstract ideas, views and practices can be taught representatively and often in mutual interdependency. In other words, whole task teaching provides the means to solve the core problem of teaching, as Alfred North Whitehead put into words:

''the problem of education is to make the pupil see the wood by means of the trees".

In this case, the wood is the essence of the school subjects and the trees are the specific situations on the basis of which the essence is worked out as a representation. It is useful to contrast this manner of dealing with content with two other commonly occurring approaches:

- Just teaching the trees; pupils learn a lot of specific facts and procedures without gaining insight into their mutual interdependence or the structure of the subject.
- Just teaching the wood; the essences of the subject are taught as abstractions without being worked out as a representation, which leave them rather meaningless for pupils.

6. Schemes and practical tips for designing whole tasks and adaptive support.

Sometimes whole tasks are already present ready-made in the current lessons and/or textbooks, in which case, such tasks only have to be moved forward (reversed.) But how can you proceed when there is no ready-made task available or when you want to you adapt an existing task? In this section a design scheme is presented. We also offer a design scheme for adaptive support. With this design scheme, the possibilities of offering adaptive support can be elaborated on further. We illustrate the use of both design schemes by an example.

Whole task design scheme

A whole task is a motivating assignments demanding pupils to use the greater part of the subject material of the class or classes concerned in a new situation. So you need two components to make up a whole task: content and situations. These are also included in the design scheme. A whole task may be designed in four steps. We formulated some tips for every step.

<table>
<tr><th colspan="2">WHOLE TASK design scheme</th></tr>
<tr><th>Content</th><th>Possible situations</th></tr>
<tr><td>Living and asking directions
• Skills:
- Writing; speaking > presenting; listening; reading
• Vocabulary on:
- types of houses, surroundings, rooms; objects in rooms; giving directions
• Grammar: Present-tense verbal forms; Imperative, sentence structure,
- Comparative/superlative
• Pronunciation</td><td>- Desiging your dream house
- Describing your own house
- Giving directions
- Comparing living in The Netherlands, Germany and Austria</td></tr>
<tr><th colspan="2">Whole task</th></tr>
<tr><td colspan="2">The teacher indicates that the target in a few lessons' time is a presentation (speaking skills) on one's own house by means of a home brochure (writing.) During the next classes, work will be done partly centrally (on the teacher's assignments) and partly independently (on the individual brochures.) There are some requirements for the production of this home brochure:
- You produce a brochure with a desription of your house and surroundings.
- You make a ground plan of your house with the German/French/English words for the various rooms.
- You elaborate on one room, i.e. your own room. You decribe what your room looks like.
- You relate something about the surroundings.
- Imagine your friend from Austria/France/England will be visiting you. Make him or her an itenary from the train station to your home.
After some lessons, everyone presents his home brochure in the specific language (2 minutes for each pupil.) This takes place in groups of three while the other pupils are working on a different task.</td></tr>
</table>

Step	Tips for executing the step in question
1. Formulate the core of the curriculum	• Limit yourself to the core. • You may want to use the core targets or end terms of primary or secondary education to determine the core of the curriculum. • Use your textbook's subject summaries.
2. Formulate possible situations in which this material is needed	• At this stage, do not be selective: write down all possibly relevant situations that spring to mind. • You could look at your textbook or exam collections to find some ideas. • Look up terms from your curriculum core on sites that have trustworthy and easily accessible information such as <kennislink.nl> and opt for images. At just a single glance, you have an overview of possible situations and you can click straight on to necessary and accessible background info.
3. Choose a suitable situation and reformulate it into a whole task	• A suitable task has to meet two criteria: it must be appealing for pupils and it must cover the core of the subject material. • Reformulate a situation into a whole task by turning it into a question/an assignment. This overall formulation of the whole task may be used at the introduction, so pupils can briefly check what they already know and are able to do. • You can easily make any task cover the curriculum by providing the pupils with a list of all terms and/or skills (from the curriculum core) to be used in the execution of their assignments. • In case of tasks that cover a large part of the curriculum, it is sensible to formulate a limited number partial questions/tasks. • Especially in cases were skills are central, it might be useful to add a rubric to the whole task. • The task can be made even more appealing by: (a) making the situation more concrete; (b) shaping the assignment in an attractive way or form.
4. Check whether the task is motivating and covers the curriculum; adapt where necessary.	• It is often useful to do the assignment sketchily yourself, so you can find out which terms and skills you actually do need to perform the task. • A task that has been worked out sketchily or partly may be of great use later as adaptive support for pupils who need it. • Use the checklist of criteria for learnability to check the quality of the task and adjust where necessary. (section 5)

Adaptive support design scheme

After the whole task has been determined, you can start designing the adaptive support. Anything normally offered during class can be considered help. Next, you can decide when which pupils are offered which help (what their options are.) Designing adaptive support usually goes in two steps, and we formulated some tips for both steps.

Step	Tips for the executing the step in question
1. Write down everything the pupils may be able to use as help for the task.	• There are three basic types of help: explanation, detailed examples and part tasks. • You can offer more, or less help of any of these. For instance, you can offer a full explanation, a summary, a scheme or just a few hints. You can give a fully detailed example, or one that has only been worked out in part, et cetera. • At this stage, write down all possible types of help that come to mind; it is not important now which pupils receive the help and in what order. • Help is often understood to mean help in the execution of the task. However, if pupils are involved in formulating the task, help may be offered at the design stage as well. Evaluating the execution of the task is also of great importance, because many lessons can be learnt from this. The amount of help offered here may also vary.
2. Decide which help to offer in which order, and whether all pupils are given the same help, or they can make a choice.	• Number the help according to the order in which you plan to present it in class. • Decide for every type of help whether all pupils receive it, or pupils can choose to get the help (D = differentiation.) • Generally, three basic patterns of help can be distinguished: direct instruction, guided discovery and master-apprentice. During class, different pupils can work with different kinds of help. • Build in 'go/no go' moments, at which pupils may only proceed after you have checked their work.

ADAPTIVE SUPPORT design scheme			
Aspects of help	**Lesson elements**	**Potential learning sequences**	
Class stages • Designing the task • Executing the task • Evaluating the task	1) Help concerning the language Teacher explanation Vocabulairy and /or grammar exercises > extra assignments for grinding in certain verbs or words	 1 4 5D	 3D 3D 3D
Type of help •General explanation •Detailed example (process or product) •Exercises (part task)	2) Help with content > examples of other home brochures or examples given by teacher 3) Help with layout home brochures > examples of other home brochures 4) Help with the standard of the brochure and/or presentation > rubrics with criteria 5) Help with 'how do I pronounce this correctly?' > audio clips, classmates, teacher 6) Help with design of presentation > classmates, teacher	2 6D 3 7D 8D	1 3D 2 3D 4D
Amount of help • A lot • Limited • A little • None			
Help basic patterns *Direct instruction* Task1 intro → explanation → pupils do task 1 *Cognitive apprenticeship* Task1 example → pupils do task 2 *Guided discovery* Task 1 intro → pupils do task 1			

The practice of teaching whole task first and adaptive support

Finally, we offer you some practical hints with respect to the implementation of differentiated challenging teaching below:

Practical hints for the implementation of differentiated challenging teaching
• Start with simple varieties of whole task first and adaptive support, so you and your pupils can gradually get used to this way of teaching (see rubric section 4.) • Critically select the core curriculum, and skip material and accompanying part tasks which are not part of the essential compulsory material. This creates space for working on the whole task, and you save your pupils from doing a lot of other small assignments (in class or as homework) besides executing the whole task and doing the relevant accompanying part tasks. • Remember you do not have to follow the textbook from front to back. In the end, the core targets or end terms for primary and secondary education are decisive for what is really compulsory. By critically deleting, you create space to make choices in the curriculum, for yourself as well as for your pupils. • Take ample time for classical introduction of the whole task, so pupils can really get excited about working on the task. • Initially formulate the whole task in understandable language: do not use complex jargon with the pupils right at the beginning. • Have pupils consider for some minutes (not much longer) how they would fulfil the task. This can take place individually or in (small) groups. This activates their previous knowledge and motivates them to start working on the task. Besides, this gives you some idea of what they can, or cannot do already. • Clearly indicate what their options for help are, what is compulsory and what is optional. (It is absolutely essential that the task instruction is clear and complete: who works with whom, how, with what result and when is it finished.) • Have pupils work on the task individually or in groups instead of discussing it in a teaching and learning conversation at the very beginning. Teaching and learning conversations can be very useful, but only after pupils have had the opportunity to do some substantial work on the task first. • Make sure you keep an eye on the pupils' progress with regard to the whole task. This can be effectuated in different ways, for instance by building in explicit 'go- no go' moments, and/or by having the pupils demonstrate their thoughts textually or visually, so when you circle the classroom you quickly get an impression of how the learning process is progressing. • If you like, you may also build in checks using mini tests so you can keep track of the pupils' progress towards the core of the subject material. • Pupils also learn a lot from reflection and discussion of their work on the task. Make sure you plan sufficient time for this.

7. Two building block expansion sets: educational perspectives and subject perspectives.

We have already demonstrated that you can easily expand your teaching repertoire by using a generative toolkit, existing of a basic set of our building blocks and two rules. In this section, we introduce two expansion sets of building blocks you can use to expand your teaching repertoire almost endlessly with. The two expansion sets have in common that the building blocks are derived from different ways of looking, thinking and working within the school subject. These different ways of looking, thinking and working are also called perspectives. Two types of perspectives can be discerned: teaching perspectives and subject perspectives. Both can direct the organization of the school subject.

- Guidelines for the organization of classes in the school subject concerned may be derived from general views on learning and teaching (*educational perspectives*.) Lessons about price elasticity in general economics classes will be organized differently from a behaviouristic perspective than from a constructivist one.
- Guidelines for the organization of classes in the school subject concerned may be derived from subject-specific ways of thinking and procedures (*subject perspectives*.) There are characteristic mentalities and procedures of economists which direct the way in which classes about price elasticity are shaped.

You can derive building blocks which are relevant to all school subjects from general perspectives on learning and teaching. More than hundred years of research into learning and teaching has yielded eleven of those. Each perspective in turn has been detailed many theories. Constructivist learning and teaching theories share a number of central starting points, but each theory fills in the details in completely different ways. For the purpose of identifying an expansion set of building blocks built on teaching and learning theories, we focus on the general starting points common to all representatives of such a perspective. Each educational perspective makes statements about the types of contents that are relevant in teaching, as well as about the way it should be done, including how pupils can be positively motivated to learn.

In the scheme below, these eleven perspectives are briefly elaborated on in terms of building blocks for what and how to learn and teach. Modern representatives of these educational perspectives all recognize the importance of whole task first and adaptive support, but different types of content for the whole task are stressed, and a certain way of offering help is accentuated from every different perspective. As a first introduction to these eleven perspectives it might be useful and fun to compose your own top-3. Tick the three types of content you think are the most important, and tick three ways of learning and motivating that appeal to you most.

Educational perspectives	**Building blocks for WHAT is important to learn**		**Building blocks for HOW to learn (*with a positive motivation*)**	
Behaviorist	Facts and procedures		Explanation and exercise with feedback *(reward)*	
Constructivist	Terms and skills		Guided discovery based on what you know and can do *(interest)*	
Socio-cultural	Competencies to participate in social practices		Copying from example and participating with decreasing help *(role identification)*	
Personalistic	Self-knowledge and self-esteem		Reflective experiential learning in a safe environment *(confidence and self-confidence)*	
Outlook on Life	Values and an outlook on life		From traditions, by example and through dialogue *(meaningfulness)*	
Critical Consciousness	Social criticism and social action		By ideology criticism and social action *(justice)*	
Self-regulation	Learning to learn		Guided planning, executing and evaluating of a learning process *(self-effectivity and self-control)*	
Ecological	Learning what is expected of you in class		By whole task instruction (who does what, how and when) *(clarity)*	
Interpersonal	Social skills		By observing, and adjusting your behaviour *(connectedness/influence)*	
Academic rationalistic	Perspectives (ways of looking, thinking and working)		By critical examination of underlying assumptions *(wonder)*	
Bounded Rationality	Efficient procedures (heuristics)		By example, copying and feedback *(practical usability)*	

Subject perspectives

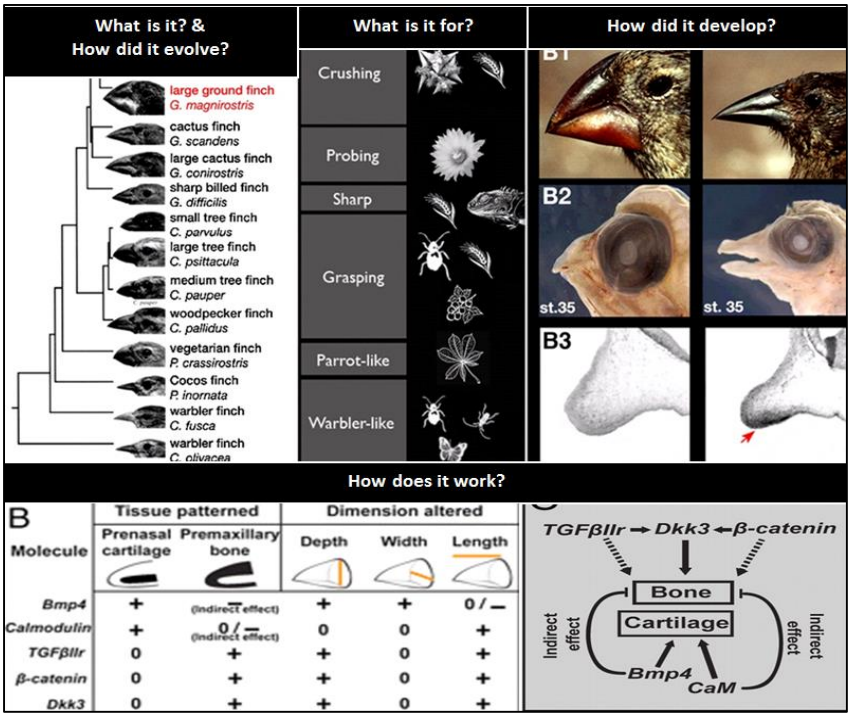
Every school subject has its own ways of looking, thinking and working. These subject perspectives define the kind of questions that are posed within the subject and which methods are used to try and answer such questions. Parts of these perspectives may in their turn serve as building blocks for the expansion of your teaching repertoire for the school subject concerned. For comparison, subject perspectives for the school subjects biology, history and language are given below.

Subject perspectives for the school subject biology

Every life form can be examined from all these perspectives.

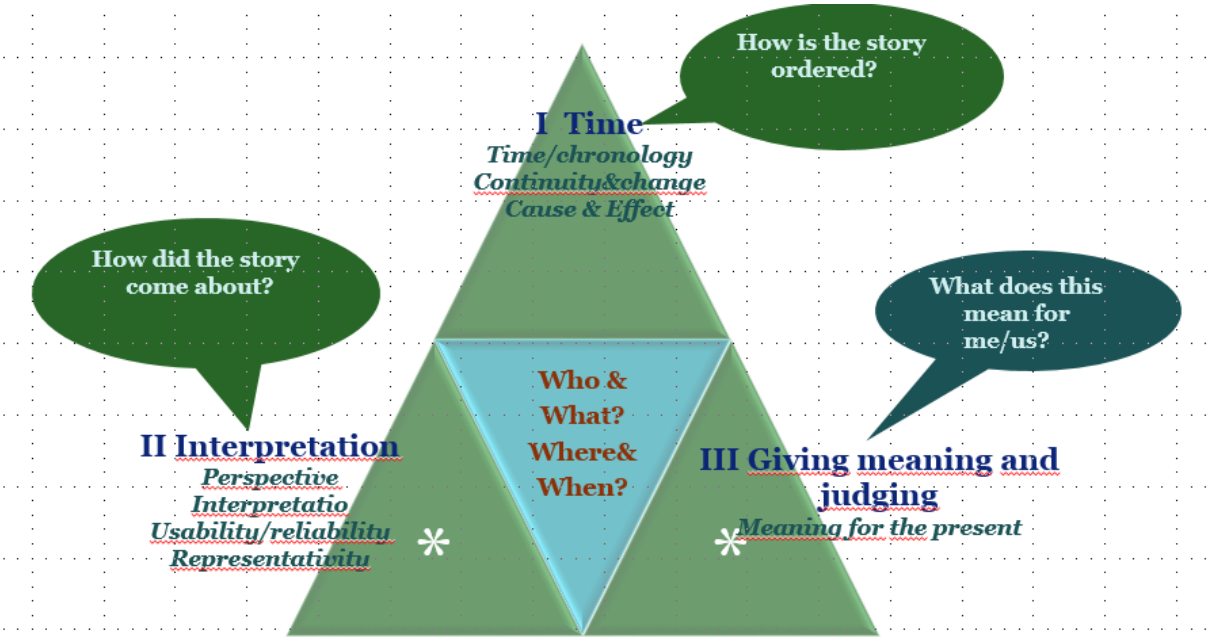
Subject perspective	**Question type**		**Methods for**		**Fundamental principles**	
Taxonomic	What is it?		Classifying		• Clsss hierarchy • Homology	
Functional	What is it for?		Functional analysis		• Functional hierarchy • Adaptation	
Mechanistic	How does it work?		Discovery of a mechanism		• Structure hierarchy • Feedback	
Ontogenetic	How did it develop?		Discovery of development patrterns		• Modularity • Generative entrenchment	
Evolutionairy	How did it evolve?		Evolutionary reconstruction		• Variation and selection • Niche construction	

Darwin's finches are a group of 14 species. They belong to the subfamily of Geospizinae. Their common ancestor arrived at the Galapagos Islands about 2 million years ago. The size and shape of the beak of each species is adapted to the kind of food that prevails in their surroundings. Size and shape of beaks is determined by two development modules. Various molecules regulate both modules, so depth, width and length of beaks can be determined independently.



Subject perspectives for the school subject history

Who-what-where-when is 'the' story / a story that someone, or a group, is telling about the past. The story can be approached from a number of subject perspectives (time/chronology, continuity & change; cause & effect; localization et cetera.) Moreover, at school you look at history with your pupils from two or more social aspects: political and administrative, socio-economic, cultural-mental, and sometimes from ecological, geographical or technological perspectives.



Subject perspectives for the school subject language

The language teacher can raise the matter of language and language usage from different perspectives:

1. Communicative/application-oriented/instrumental/strategic perspectives: (learning) to use language with different goals and in different situations: reading skills, writing skills, oral proficiency, argumentation, reflection on language use in order to improve.
   PROFICIENCY/TEXT SCIENCE
   How do you use language, and how do others do it? How can you improve this? (giving information and processing information; instrumental, functional)

2. Normative perspective: language norms, conventions, spelling, vocabulary; to fight or not to fight language change?; use of reference works.
   PROFICIENCY/PROPER LANGUAGE USE
   How do you judge language & language use, what is 'done' and what is not? When? (correction)

3. Aesthetic/cultural-historic/personal perspective: reading literature, culture; literary history
   OLD AND MODERN LITERATURE
   How do you perceive or judge literary language use, also in historical perspective? (interpretation, imagination)

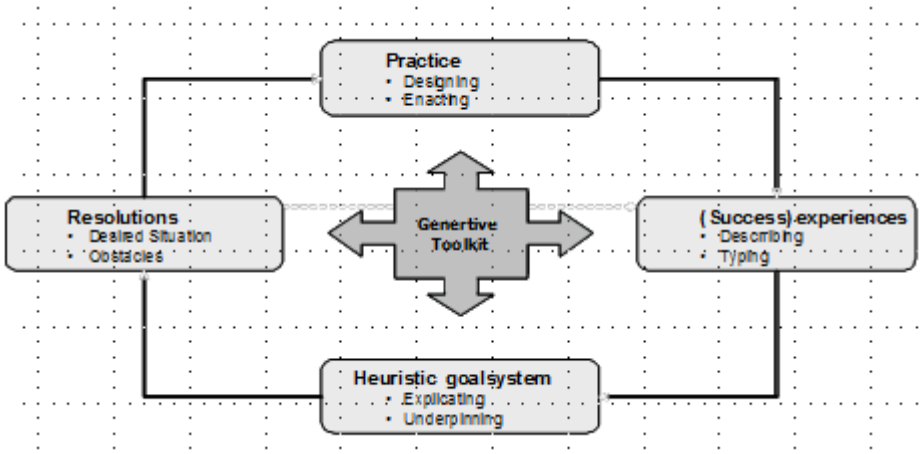
4. Structural-analytical/descriptive perspective: grammar, argumentation structure; literary analysis, close reading
   STRUCTURAL LINGUISTICS, LITERARY SCIENCE
   How is language (use) structured? (description)

5. Psychological/explanatory/ 'inner language' perspective: language production and processing linguistic utterances, language acquisition; language disorders. Reflection on language as a mental capacity.
   LINGUISTICS/PSYCHOLINGUISTICS
   How do you acquire/learn language, how do you interpret your language? Which views and prejudices exist? How can you study language acquisition? (hypothetic-deductive method)

6. Socio-cultural/explanatory/ 'outer language' perspective: language variation, language change, language evolution, vocabulary, spelling. Being interested in language changes. Reflection on language as a socio-cultural phenomenon.
   SOCIOLINGUISTICS/DIALECTOLOGY and HISTORIC LINGUISTICS
   How does language vary and change? How is language use related social status? Which views and prejudices exist? How can you study language variation and language change? (hypothetic-deductive method)

8. The generative toolkit for shaping your own learning track.

We will now demonstrate by using a case study how you could use the generative toolkit, including the two expansion sets, for shaping your own teaching methodology learning track, where you keep on expanding your teaching repertoire. As we already indicated at the beginning of this brochure, we aim for a learning track where step by step, you build on what you already know and can do, so you can stay in *flow* and avoid the sense of loss of control on the one hand, and boredom on the other. To expand your repertoire, you repeatedly go through a cycle of designing classes, looking back on your experiences and what you learn from this, which results in new intentions, based on which you can go through the cycle again. The notion of expanding the repertoire by a cyclic process of designing, executing and evaluating your lessons is not a novelty of course. However, we add three elements here which do not only make cyclic and reflective experiential learning more fun, but also, more productive.



Expanding your teaching repertoire by cyclic reflective learning from experience

Toolkit

We already introduced the most important addition, the generative toolkit. We put it at the centre of the cycle, because the toolkit may direct you in learning from experience, as well as in formulating new intentions and designing classes. In other words, the toolkit causes you to continuously discover new choices and possibilities concerning the ins and outs of your classes.

Successful experiences

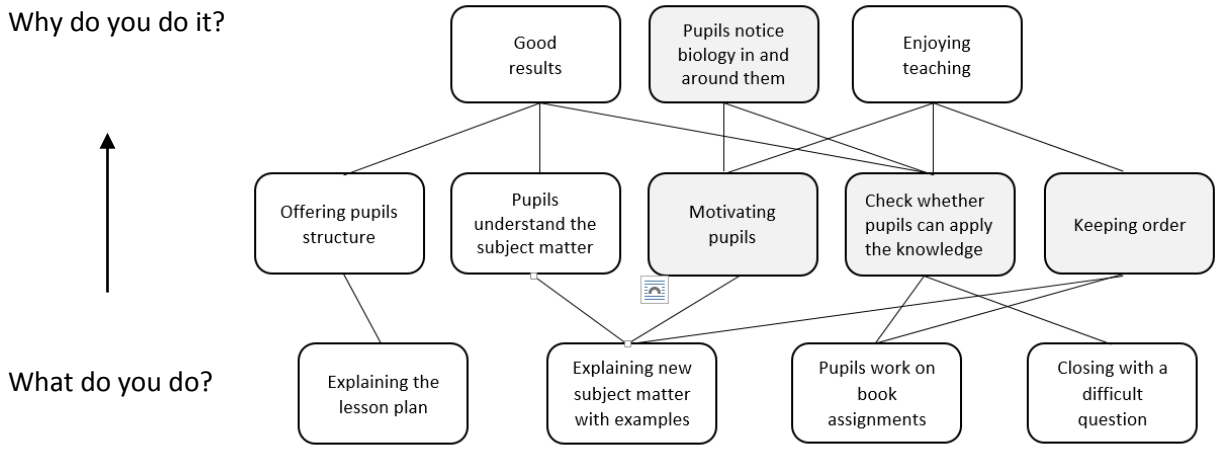
A second element we wish to stress is the importance of learning from successful experiences. In experiential learning, usually learning from your mistakes is emphasized. Research shows however that it is often hard for teachers to get to productive intentions by reflection on problematic experiences, and being motivated to execute them. In many cases, reflection on problematic experiences results in intentions to avoid such situations in the future. However, if you look back on teaching you experienced as successful, this usually results in much more productive and innovative intentions, and you tend to be more motivated to execute these on top of that. For in a successful experience, something happened that you want and are able to do,

and by focussing on this, you do not only discover what you really think is important, but also, you find the seed of the approach you can use to reach your target. Your expectation of success is enhanced because you build on what you already were successful at, and therefore, your motivation to actually execute your intentions is also enhanced.

This is not to say that learning from problems is not useful, but in this case, it is often more productive to mobilize relevant success stories first and learn from those. Suppose you had a teaching and learning conversation in the fifth year which failed completely, whereas in the same week, you had a teaching and learning conversation in the third year that went absolutely great. It is useful to find out what exactly was different in your third year conversation and what was your role there, in order to use this for improving the teaching and learning conversation in the fifth year.

Goal system

The third and last element we add to the regular reflective experience cycles is the goal system as a means of demonstrating compactly what you do in your classes and why you do it like that. Your goal system represents your model practice of teaching, and therefore directs your acting in the classroom. As an example, we briefly discuss the goal system of biology teacher Ilse.



A teacher's goal system

A goal system can easily be 'elicited' with a laddering interview. As the interviewer you need an A3 sheet and a bunch of post-it notes. The interview will proceed as follows:

1. The interviewer asks the teacher to bring a representative class to mind, and then describe what he or she does in such a class, and in what order ('from bell to bell'.) The interviewer writes every part of the class on separate post-it sheet, in the teacher's wording.
2. Then the teacher is invited to state for each part why he or she thinks this is important. These answers are also taken down literally on separate post-it sheets and stuck unto the A3 sheet. Every part of the class can contribute towards several targets. Every target – means relation is connected by an arrow. The interviewer can ask more questions about each target, why the teacher thinks this target is important, until the teacher has 'arrived' at his/her most important teaching targets.

3. Finally, the teacher is asked to indicate – with a colour or a symbol – which targets from the goal system were realized satisfactorily (white blocks in Ilse's goal system) and which target were not met as well (grey blocks in Ilse's goal system van Ilse.)

Summarizing: with the help of the generative toolkit, a teacher can expand his or her teaching repertoire step by step by formulating intentions, detailing these into concrete lessons, learning again from successful experiences, which in turn direct new intentions et cetera, building on his/her goal system.

Illustration of step by step expansion of the teaching repertoire

We now briefly describe a part of Ilse's learning sequence, starting by a short characterization of her initial situation. Ilse's goal system indicates clearly how her classes used to proceed. After Ilse's explanation of the new subject material, pupils would start doing assignments from the work book. Ilse used to end the lesson by asking a difficult question, to see if the pupils were able to apply the material. She was generally quite happy with this approach, but it bothered her repeatedly that some pupils were not paying attention during her explanation. She had had to warn regularly and sometimes ended the explanation part early and let the pupils work by themselves. She also regretted the fact that she had not yet been able to put an important goal of hers into practice. She was under the impression that the pupils viewed biology as something from a book, rather than realizing it is constantly present in themselves and their surroundings.

She then started to expand her repertoire step by step by using the generative toolkit, ever building on what she was already doing and using the positive experiences from adaptations she had applied. During the first step, she only used the basic set, and in the following steps she also used both expansion sets as an inspiration. After she had tried something else again, she consulted the building blocks of the expansion sets anew, and using this and her previous experience, decided what her next step could be. We briefly describe five steps from her learning sequence. We state her intention at every step, as well as the teaching experiment she conducted. The steps are numbered 1 to 5. The schemes with building blocks from both expansion sets are also marked with the numbers 1 to 5 to show which building blocks served as a source of inspiration for the teaching on experiment.

Five steps in a teacher's learning sequence

1	*Intention*	*I would like to try reversal*
	Teaching experiment	An ecology class which I used to end by challenging the pupils with the following statement by Marianne Thieme: "A vegetarian in a Hummer is more environmentally friendly than a 'meat eater' on a bicycle", I now start with this statement, and they start working on it after the explanation.
2	*Intention*	*I would now like to start with real-life context and try the master-apprentice approach next.*
	Teaching experiment	The class on photosynthesis starts with a horticulturist's issue of wanting to up his production. I use this case to for explaining photosynthesis. Then the pupils have to come up with an experiment in which they can demonstrate photosynthesis.
3	*Intention*	*I want to let pupils choose between direct instruction and guided discovery.*
	Teaching experiment	Pupils are assigned to design an artificial heart. They have a choice of whether to listen to the explanation first, or immediately start off with the functional strategy.
4	*Intention*	*I have noticed that a complete task instruction is essential for discovering learning.*
	Teaching experiment	In a parallel class I taught the same lesson, but now I indicated much more clearly what they have to do, with whom, how, and what they have to deliver at the end.
5	*Intention*	*I want to acquaint pupils with different ways of biologic thinking*
	Teaching experiment	In the framework of a series of lessons about evolution, pupils could choose an animal or a quality. Then they question the chosen theme from four perspectives, producing a kind of collage with captions, and formulate and visualize the answers by consulting various sources (*cf* collage of Darwin finches as an example.)

Typing of each step with building blocks from the teaching perspectives

Teaching perspectives	**Building blocks for WHAT is important to learn**		**Building blocks for HOW to learn from a positive motivation** *(Italic)*	
Behaviorist	Facts and procedures	**1**	Explanation and exercise with feedback *(reward)*	**1**
Constructivist	Terms and skills	**3**	Guided discovery based on what you know and can do *(interest)*	**3**
Socio-cultural	Competencies to partake in social practices	**2**	Copying from example and participating with decreasing help *(role identification)*	**2**
Personalistic	Self-knowledge and self-esteem		Reflective experiential learning in a safe environment *(confidence and self-confidence)*	
Outlook on Life	Values and an outlook on life		From traditions, by example and through dialogue *(meaningfulness)*	
Critical Consciousness	Social criticism and social action		By ideology criticism and social action *(justice)*	
Self-regulation	Learning to learn		Guided planning, executing and evaluating of a learning process *(self-effectivity and self-control)*	
Ecological	Learning what is expected of you in class	**4**	By whole task instruction (who does what, how and when) *(clarity)*	**4**
Interpersonal	Social skills		By observing, and adjusting your behaviour *(connectedness/influence)*	
Academic rationalist	Perspectives (ways of looking, thinking and working)	**5**	By critical examination of underlying assumptions *(wonder)*	
Bounded Rationality	Efficient procedures (heuristics)		By example, copying and feedback *(practical usability)*	

Typing of each step of the learning sequence with building blocks from the subject perspectives

Subject perspective	**Question type**		**Methods for**		**Fundamental principles**	
Taxonomic	What is it?	**5**	Classifying		• Clsss hierarchy • Homology	
Functional	What is it for?	**3** **5**	Functional analysis	**3**	• Functional hierarchy • Adaptation	
Mechanistic	How does it work?	**1** **2** **4** **5**	Discovery of a mechanism	**3**	• Structure hierarchy • Feedback	
Ontogenetic	How has it developed?	**5**	Discovery of development patrterns		• Modularity • Generative entrenchment	
Evolutionairy	How has it evolved?	**5**	Evolutionary reconstruction		• Variation and selection • Niche construction	

In conclusion

In this brochure we introduced a generative toolkit for permanent expansion of a teaching repertoire of differentiated and challenging education. We hope the toolkit inspires you keep on discovering new sides of your pupils, your subject and of yourself as a teacher.

More information on theoretical backgrounds, empirical results and applications

Please consider this brochure a brief progress report of an ongoing research design about teaching repertoire development of teachers. The research started 15 years ago, and has not been finished by far. A great number of cycles of theoretic exploration, design, execution and trying out have resulted in a theory and evidence-based approach which is presented in this brochure. At first, the research was directed only at repertoire development of biology teachers. Gradually, the target group was widened up to teachers of other school subjects in primary and secondary education, and we are now trying out applications for vocative training and university training. Widening up the target group has resulted in a similar expansion of the group of colleagues (teachers, trainers and researchers) working together. These partnerships and other developments have resulted in a new research field: 'practicality studies.' The purpose of this research is to gain insight into the practical thoughts and actions of teachers, based on which methods can be developed for making educational innovations practicable. Within the framework of this research, we also cooperate and publish together with renowned American teacher researchers.

Below, you will find a list of key publications for those who would like to know more about the theoretical background, empirical research and applications of the approach discussed in this brochure. Some links to relevant videos are also added.

Hulshof, H (2010). Praktijkkennis van docenten: de zoektocht naar patronen, taal en vooruitgang. In Rijst, R.M. (ed). *Verhandelingen over de leraar*. (pp. 67-74). Universiteit Leiden

Janssen, F.J.J.M. & Verloop, N. (2003). De betekenis van perspectieven voor leren leren. *Pedagogische studiën*, 5, 375--391.

Janssen, F.J.J.M., Hullu, A. E. de & D.H. Tigelaar (2008). Positive experiences as input for reflection by student teachers. *Teachers and Teaching: Theory and Practice*, 14, 115-127

Janssen, F.J.J.M., Veldman, I. & J. van Tartwijk (2008). Professionele docenten opleiden: Een opleidingsvisie. *Tijdschrift Voor Lerarenopleiders*, 5-13.

Janssen, F.J.J.M., de Boer, E., Dam, M., Westbroek, H.B. & N. Wieringa (2013). Design Research on Developing Teaching Repertoires. In Plomp, T. & N. Nieveen. *Educational Design Research. Introduction and illustrative cases*.(pp 757-780). Enschede: SLO.

Janssen, F.J.J.M., Westbroek, H.B., Doyle, W. & Driel, van J.H. (2013). How to make innovations practical. *Teachers College Record, 115 (7), 1-43.*

Janssen, F.J.J.M., Westbroek, H.B. & van Driel, J.H. (2014). How to make guided discovery learning practical for student Teach/.;*Instructional Science, 42,* 67-90.

Janssen, F.J.J.M. , Westbroek, H.B. & W. Doyle (2014) The practical turn in teacher education. Designing a preparation sequence for core practice frames. *Journal of Teacher Education*, 65(3), 195-206.

Janssen, F.J.J.M., Westbroek, H.B. & W. Doyle (2015). Practicality studies: How to move from what works in principle to what works in practice. *Journal of the Learning Sciences, 24*(1), 176-186

Janssen, F.J.J.M. & B. van Berkel (2015). Making philosophies of science education practical for science teachers. *Science & Education*. 24 (3) 229-258.

Janssen, F.J.J.M., Grossman, P. & H.B. Westbroek (2015). Facilitating decomposition and recomposition in practice based teacher education. The power of modularity. *Teaching and Teacher Education*., 51, 137-146.

Click on the hyperlinks below for relevant videos

Beknopte kwaliteitskaart over omdraaien en weglaten met kennisclip
Weblecture over achtergronden en toepassingen van de generatieve toolkit
A presentation by Professor Walter Doyle about our research programme 'practicality studies'

Appendix: detailed examples for different school subjects[1]

Language: ccvc and cvcc words
Gera Nieuwenhuis

Numeracy: Percentages, decimal numbers, measuring, money, content
Natasja de Vrind

World orientation: countries
Edith Vingerhoeds, Marjolein Hazewinkel and Fred Janssen

Modern foreign languages: First language lesson - introducing oneself
Wilma Kruithof

Language: synonymous sentences
Anneke Wurth, Ad van der Logt, Peter Arno Koppen and Hans Hulshof

Greek and Latin Language and Culture: Croesus
Marijne Ferrante

Philosophy: World-wide justice
Dirk Oosthoek

History: Crusades
Elise Storck en Saskia Groot

General Economics: Price elasticity
Ton van Haperen

Management & Organisation: Forms of financing
Jeffrey Bouwer

Sociology: Migratory movements
Koen Schaap and Arthur Pormes

Geography: Zoning plan
Maurice van Werkhooven

Chemistry: Acids and bases
Hanna Westbroek and Cris Bertona

Biology: Heart and circulatory system
Fred Janssen

Physics: Circuits
Hans van Bemmel and Hans Betlem

Mathematics: Start of exponential functions
Peter Kop and Anne van Streun

[1)] The example lessons presented here are part of a larger collection of examples of lessons differentiated in challenge developed by teachers and teacher educators in the context of a project financed by the Dutch Ministry of Education, Culture and Science. The complete collection will become available by December 2015.

LANGUAGE
ccvc and cvcc words

Before
The teacher explains about the reading and spelling of the categories of *ccvc* and *cvcc* words such as *flood*/*much*/*snow*/*word* (c is for consonant, v is for vowel.) After this, the pupils start doing a lot of exercises with those words.
After reversal and omission
Whole task first The pupils are instructed to make a memory game, with sets of two cards belonging together (picture and word.) They can only choose pictures of *ccvc* and *cvcc* words, such as *flood* and *word*. *Adaptive support* 1) Explanation about vowels and consonants and how to write such words. 2) Related 'fill in the blanks' exercises from the workbook. 3) Support in the shape of cards with *cc*-combinations and/or some pictures. 4) Choosing from an example list of words. Pupils who do not need help start off making the memory game with just a few examples. Pupils still finding it difficult get an explanation and do some 'fill in the blanks' exercises. Pupils who still need extra support receive cards with *cc*-combinations and get to choose from the example list of words.

NUMERACY

Percentages, decimal numbers, measuring, money, content

Before
The teacher explains the material concerned, with extra instruction where necessary. The pupils do the accompanying exercises from the workbook. The groceries task detailed as a whole task below is an elaboration of a project task which is sometimes skipped, or only done by pupils who finish early.
After reversal and omission
Whole task first The teacher introduces a shopping bag with groceries, wallet and shopping list. The assignment for 11-years old pupils is to do the grocery-shopping for dinner for 30 pupils for one night of school camp. After composing the menu, the teacher explains the assignment. *Adaptive support* One group (***) immediately starts comparing advertising brochures from supermarkets. When they are done, they are referred to relevant assignments in the workbook. The two other groups are instructed about the subject material first. Then one group (**) starts calculating how much food is actually needed for such a large group, and they calculate the costs for a number of products. Pupils from the other group (*) are first going to do the exercises in the workbook about the subject material. The teacher adds more instruction when needed. Then they will calculate how much is needed of a product from the menu, and what the total costs will be. The teacher goes around the three groups to monitor progress and give feedback, having a more steering role in groups ** and ***. Then the contributions of the groups are discussed centrally to arrive at a definitive shopping list including amounts and prices.

W0RLD ORIENTATION
Countries

Before
On the basis of two example countries (China and The Netherlands) the teacher explains that counties differ in various aspects, such as economy, politics, culture, ecology. After this the pupils start with an assignment where they have to apply one aspect to a concrete situation every time. The teacher ends with a video clip of a little boy growing up in the slums of Mexico-City. He describes a day of his life.
After reversal and omission
Whole task first The teacher first shows the video clip of the little boy from Mexico-City. Pupils are blindfolded and assigned (in threes) to choose a spot on the globe. This spot is where they were born. They have to describe a day out of their own life, including information about various country aspects (politics, economy, culture, education et cetera.) After this, they have to perform a 5-minute play about this day in their life. *Adaptive support* Pupils are each handed a work sheet with a space in the middle to write their country in. There are circles around it with key questions about the different aspects they have to find information on for their descriptions. They are also given *links* to two websites where they can find dependable country information. Pupils who need more help receive a fully detailed worksheet about the little boy in Mexico-City. When pupils wish to know more about a certain aspect, they are referred to the relevant part task in the method.

MODERN FOREIGN LANGUAGES
First language lesson: introducing oneself

Before

The teacher starts the very first language lesson with the dialogues from the beginning of Chapter 1. She goes through them twice, and then zooms in on the verbs in the dialogues. Next she explains how these verbs are conjugated on the basis of a grammar survey. After that, the pupils start working on the assignments in the workbook. They translate words and complete sentences by filling in missing verbal forms.

After reversal and omission

Whole task first

The teacher speaks the target language and introduces herself. She adjusts her language use (vocabulary and speed) to the target group and makes supporting gestures. She tells her name, where she lives, her age, that she travels to school by train, and she also talks about her brother and her hobbies. Photographs appear on the smartboard during her presentation. This also supports the understanding of the target language. At the same time, the images and the presentation form an example of the product (introducing yourself with images) which the pupils have to deliver in a few lessons' time.
Work on this presentation is started during the first lesson. The following task is assigned to the pupils:

- Everyone has to be able to introduce himself in the target language (name, domicile and age) and to ask another person for these
- Optional: being able to introduce someone else (use of he/she)
- Optional: asking questions and being able to talk about other subjects
- Everyone has to do pay attention to pronunciation while doing this
- Everyone has to be able to explain how the verbs are used in 1st and 2nd persons

By the end of the class, various dialogues are presented, and the verb conjugation is explicitly given. In the next few classes, the introductions will be expanded by learning more language elements.

Adaptive support

During this first lesson, the teacher considers the dialogues, grammar survey and exercise as help. The pupils are given the following options:

- Pupils leaf through Chapter 1 by themselves and look for the information needed to do the assignment. They can listen to the dialogues with headsets.
- The teacher gives the pupils a manual with references to pages, explanations and exercises (they can go through the steps independently.)
- Pupils follow the steps under the guidance of the teacher to arrive at a good dialogue.

LANGUAGE

Sentences with equal meanings

Before

The teacher explains what synonymous sentences are by using some examples. When one sentence has the same meaning as another, that sentence is a paraphrase of the other one. Next the pupils start reading the explanation in the book and make six exercises from the book on the subject. What has not been finished in class will be given as homework.

After reversal and omission

Whole task

The teacher tells the pupils to do the exercise 1 in section 1, which is, the pupils demonstrate the meaning of three non-synonymous sentences with a drawing. Then they are given two synonymous sentences and are asked again to illustrate the meaning of the sentences with a drawing. They discover that just one drawing suffices in this case.
Next, the pupils are shown the section title in the book again: 'Sentences that do not look alike, but have the same meaning'. The problem definition is now clear to them. After this they can deal with making the notion explicit and processing it by doing the rest of the exercises.

Adaptive support

The pupils may use any, or none of the following kinds of help:

- The teacher gives extra explanation.
- Pupils have to sort a number of sentences into two classes: one with pairs of synonymous sentences, the other with sentences without a matching synonymous one.
- New examples can be given or demanded, so you may be assured that the pupils recognize synonymy even before a definition has been given.

GREEK and LATIN LANGUAGE AND CULTURE
Croesus

Before
The speech in which Croesus tries to convince King Cyrus is translated word by word. Then the pupils start doing the reading comprehension assignments about the speech.
After reversal and omission
Whole task first After a short introduction of the context of Croesus' speech, the pupils are asked in what way Croesus is trying to convince King Cyrus. *Adaptive support* Next, pupils then start to translate the text word by word and then try to briefly describe the construction of Croesus' argument. They could use the following progressing kinds of help: - The argument is built on four parts. Find the starting and end points of each part and summarize the essence in no more than 10 words. - Pupils who get stuck are given the starting and end points of each part. - Pupils who still have difficulty are referred to some reading comprehension questions from the book which can help them to better understand parts of the text.

PHILOSOPHY
World-wide justice

Before
The teacher explains four paired terms and three views concerning moral responsibility. The pupils practice with these paired terms in part tasks. Next, the pupils have to apply the paired terms and views to an actual case (e.g. hunger in the Horn of Africa.)
After reversal and omission
Whole task first The teacher introduces the case Hunger in the Horn of Africa. Are we partly responsible? *Adaptive support* The teacher briefly explains four paired terms and three views. After that, all pupils start working on the case. They have to use the four pairs and three views. The pupils who get stuck are referred to some selected part task and/or a detailed example of a different case.

HISTORY
Crusades

Before
The teacher shows a clip from the film *Crusade in Jeans* and then explains what crusades are, and why they were undertaken. Next, the pupils do assignments from the textbook.
After reversal and omission
Whole task first The teacher shows a clip about the crusaders' hardships from the film *Crusade in Jeans* or reads a passage from the book of the same title by Thea Beckman. The teacher asks pupils to think about the people they saw, and what motives they may have had to deal with so much hardship. (Chances are, the pupils come up with this question already.) Next, they are instructed to find as many possible explanations as they can for why these people organized crusades and/or embarked on them. *Adaptive support* They can choose from: A. Hardly any instruction: finding out independently (or in twos or threes) by using the text book and primary sources who organized and took part in the crusades and why, and presenting this to the rest of the class, possibly grouped into religious, political, social or economic motives. B. A little instruction: finding out independently (or in twos or threes) by using a worksheet from the text book and primary sources who organized and took part in the crusades and why. C. A lot of instruction: studying the textbook and primary sources to find out, with instruction from the teacher and under his or her guidance, who organized and took part in the crusades and why, and filling in the findings on the worksheet. After this, groups A present their findings, and groups B and C give feedback by using their own worksheets. The class ends with a discussion of what motives were most important to whom, which motives were mutually reinforcing or opposing, or to what extent this can be compared to motives to fight along with IS.

GENERAL ECONOMICS
Price elasticity

Before
Start treating demand price elasticity; calculating the number on the basis of the textbook definition, using a ceteris paribus demand curve. Calculating with price elasticity; determining a third unknown variable on the basis of two known ones. Doing this over and over by following the assignments in the textbook. Ending with a case, for instance: the increase on excise duty on spirits and how that influences government revenues.
After reversal and omission
Whole task first Starting with the case of excise duties and spirits. Demonstrating that tax revenues may rise or fall at an increase of excise duties. Subsequently introducing the ceteris paribus demand curve of spirits, raise different prices and see what happens to the turnover, drawing a conclusion based on this concerning the tax revenue and then distilling the notion of price elasticity of demand from that. Closing with a control case with a surprising outcome: customers react unexpectedly strong to a price increase on cigarettes, because the price is high-up in the demand curve. This way, you also get to eliminate a misconception: it is not the curve that is either elastic or not, it is the price on that curve that is elastic. *Adaptive support* A number of students can start with some cases after the definition of price elasticity has been laid down and some calculations were done. The rest will get additional instruction on determining the definition, interpretation of the outcome and calculating with the result.

MANAGEMENT & ORGANISATION
Forms of financing

Before

In a regular lesson about forms of financing, the teacher starts with an explanation of the various forms of long-term loan capital. After this, the pupils start doing some assignments from the textbook. These are part tasks relating to the terms discussed. Only a small part of the subject material is needed to do the assignment, for instance a fill-in-the-blanks diagram where missing numbers have to be added.

After reversal and omission

Whole task first

The teacher chooses a couple of whole tasks which he thinks are appealing for the pupils, and for which they need knowledge of the various forms of long-term loan capital in order to be successful. He brings one of these tasks forward so he can now start his class with one.

Mrs. L. Post-van den Akker wants to buy a house. The bank is willing to give her a 4% mortgage loan of € 300,000 with a term of 25 years. She receives an offer from the bank in which the following three options are presented to her:

A. A mortgage loan with linear repayments: total amount payable for instalments and interest during the period to maturity is €456,000.
B. A mortgage loan with annuity repayments: total amount payable for instalments and interest during the period to maturity is €480,089.70.
C. A mortgage loan in the form of a savings-based mortgage: total amount payable for savings premiums and interest during the period to maturity is €480,089.70.

- Explain that with a linear repayment the total amount payable is lower than with annuity payments.
- Explain why a savings-based mortgage can be more attractive than an annuity mortgage.

Adaptive support

Pupils who think they can do the assignments without explanation start working with only referral to the fill-in-the-blanks diagram for financing forms in the book. The other pupils listen to the explanation of the concepts and then take on the whole task. Pupils who still don't feel ready to do the whole task after the explanation will do part tasks first. They can do the fill-in-the-blanks diagram before starting on the whole task.

SOCIOLOGY
Migratory movements

Before
In the regular class about migratory movements the teacher will start by showing the interactive map of global migration: http://migrationsmap.net/#/NLD/arrivals. The starting point is The Netherlands. The teacher asks pupils about possible reasons for migration and complements the list. After this, he will sketch what the history of migration from and to the Netherlands has looked like since World War II. When the previous goes quicker than expected, the teacher may show other countries, or pupils can start making assignment from the book.
After reversal and omission
Whole task first The teacher writes the whole task for the class on the blackboard. "Produce a survey of the main migratory movements and reasons for migration from and to The Netherlands and other countries." Pupils have to write down in silence, by themselves what they think the reasons are. Then the teacher will show the interactive map of global migration (http://migrationsmap.net/#/NLD/arrivals.) The teacher indicates the options of a whole task at basic, average or high level, and that the pupils can work in twos or threes. At basic level, they have to choose a country individually or in twos, and investigate online where immigrants come from and where emigrants are going. Subsequently, they have to find information about the reasons behind this migration and work them out in a survey, in which they compare their chosen country to the Netherlands. At the higher levels, the pupils are asked to compare countries, come to conclusions and give a substantiated opinion on the Government Policy of 'Shelter in home region.' *Adaptive support* The pupils will have to look for additional information with all the assignments (less with the basic assignment than with the more difficult one.) The teacher does not immediately tell the pupils where they may find this information, but lets them look by themselves. After some time (15-20 minutes) the teacher halts the class and asks who needs more explanation. Depending on the number of pupils who want more explanation and the distribution of the assignment levels he may decide to: - give a general explanation (when many groups are working on the same assignment and come up with the same questions) - compose a separate group for explanations (same, but with a representative of every group needing explanation) - explain to each group (by talking the groups and answering specific questions – when the groups differ a lot in level and in questions) When the pupils have finished, they are handed a check-up sheet (except at the high level) and they can choose a simpler or more difficult assignment. The teacher takes in the advices and will give feedback during the next class.

GEOGRAPHY
Zoning plan

Before
Pupils learn that the space in the landscape is planned, and that choices have to be made. Such choices are laid down in Spatial Planning Bills (national,) Regional Planning and Zoning Plans (local). When there is time left, the following assignment is given at the end of the series of classes: "This is a map of a large amount of open space. Sensibly plan this area with your group, using everything you have learned so far, with due regard for a number of requirements and wishes from the local council.
After reversal and omission
Whole task first Pupils are asked to design an expansion of their town. They present it in a concise zoning plan. All pupils receive some relevant key figures on their municipality. *Adaptive support* During the work, the teacher offers these consecutive forms of help: a. Oral feedback, with probing questions about the whys and wherefores of the choices made b. List of criteria: what requirements does a Zoning Plan have to meet? c. Advice to make part tasks: think in terms of the four kinds of space distribution: living, work, recreation and traffic between the three. Traffic includes road, water and air traffic, but also telephone connections, wireless connections, electric wiring, et cetera. Check for all these four kinds of use how much space is needed, and how you want to shape it. d. Finally, pupils can be referred to relevant exercises in the textbook for parts of the task.

CHEMISTRY
Acids and bases

Before

In fourth grade, acids were discussed: what they are, what a strong acid is and how you can determine its pH value. In fifth grade, we teach pupils what bases are, and acid-base reactions in a series of lessons and with explanation and assignments from the textbook. In final assignments and practicals, applications are also discussed. This is a cookbook practical in which pupils try to find out step by step which substances would be suitable to use in heartburn tablets by using a detailed instruction.

After reversal and omission

Whole task first
The teacher explains what heartburn is, and that tablets exist to remedy this. The teacher asks the pupils to indicate whether certain substances (calcium sulphate, calcium hydroxide, calcium carbonate and calcium chloride) would be suitable for heartburn tablets. Then Pupils are asked to design an experiment to investigate which substance would be suitable, and to do the test, after having it checked by the teacher or technical teacher assistant. On the basis of their findings and by using the theory from the textbook and additional information from reference works on solubility and toxicity, they have to think up which reactions will occur and which substances will be created. On the basis of what they have learned, they now have to make a founded choice – based on the experiment and information about the properties of the substances such as solubility, toxicity etc. which of the suggested substances is preferred for producing heartburn tablets.

Adaptive support
The original detailed practical instruction is divided into parts for this purpose. In case pupils cannot conceive the next step of their experiment, they are given a part of the practical instruction so they can take the next step. As an illustration, two consecutive parts of the instruction are given below.

A. You are going to add little scoops of the substance mentioned above to this acid solution. To check whether there is a reaction, you look for a change in the pH value of the acid solution.

B. Look up in the reference book which indicator is suitable, and which colour change you can expect when there is a reaction. Fill in the table below for two potential indicators.

Name indicator	Colour in acid solution	Colour after reaction

BIOLOGY
Heart and circulatory system

Before
The teacher explains the human heart and circulatory system. Next, pupils start doing assignments from the book. One of the assignments concerns drawing the heart and its in- and outgoing vessels onto a T-shirt. The teacher usually skips this assignment because it takes too much time.
After reversal and omission
Whole task first The teacher realizes that by using this T-shirt method, pupils could prepare and execute a heart transplantation, at which all important terms have to be applied. He then formulates the following whole task: "You and your team are going to execute a heart transplantation. First, you have to make a choice which patient gets priority: a 33-year old chain smoker or a 75-year old athletic non-drinker and non-smoker with a predisposition for arteriosclerosis. One of the pupils in the group acts as the patient, and the donor heart has arrived. First, you prepare the operation with your team and the patient. You write down the sequence of what you are going to do and why. When your operation plan has been approved, you may start executing the operation with the T-shirt-method. After this we explore in the classroom who should be prioritized and what this means for your own lifestyle." Pupils receive a list of terms the have to use in the description of their surgical protocol. *Adaptive support* Pupils may choose whether they would first like to listen to a brief explanation of the subject matter by the teacher or watch a simulation of heart and circulatory system on the biology site later. The teacher himself has worked out a surgical protocol and made two varieties: one in which only the captions are left, so pupils only see the main steps, and one in which every main step is elaborated a little further, but some steps are left for pupils to fill in.

PHYSICS
Circuits

Before

The teacher explains the new subject material about circuits and the pupils start doing assignments from the book. One assignment is about the changeover switch. The switch is given in this case, and pupils are asked to explain how it works.

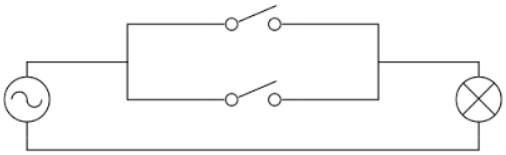
After reversal and omission

Whole task first
The teacher uses the assignment about the changeover switch as a task, but instead of asking pupils how a given circuit works, he asks them to design such a switch.

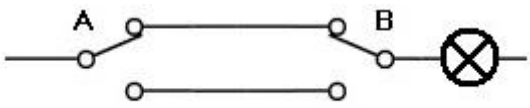
This is how the teacher introduces the whole task:

"Raise your hand if you have the following at home: When you are at the bottom of the stairs, you can switch on the light over the stairs. You walk upstairs; there you can switch off that lamp by a different switch. Okay, many people recognize this. There is no switch-on and switch-off switch, because upstairs, you can also switch the lamp either on or off. The switches always yield a change in the situation: from on to off, or from off to on. This is called a 'changeover switch.' Your assignment is to design a switch that meets these requirements. So for the next 10 minutes, start working in twos, drawing a circuit with the light, the two switches and the wires. If you get stuck, you may ask for a help sheet."

Adaptive support
Help sheet: One of the circuits below is the right one. Explain which one.



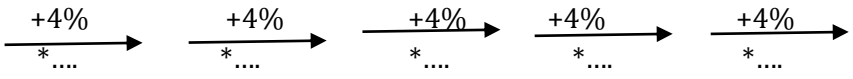
A



B

C

MATHEMATICS
Start of exponential functions

Before
The teacher explains how you can use the growth percentage to find the growth factor and how to use it. He also presents the formula for an exponential function. Pupils will do exercises about this, and in some cases, they will work out why a certain function fits the given situation.
After reversal and omission
Whole task first Below is a whole task solely based on knowledge of percentages. This assignment is a prototypical example of an exponential function. You put 1000 euro in the bank and you receive 4% interest annually, which is added every year. How much money do you have in this account in 10 years' time? *Adaptive support* Pupils may use any or all of the kinds of help below to do this assignment. Help 1: 17% of 300 = …. times 300; 20% of 160 = … times 160 Help 2: Last week, a shopkeeper raised his prices by 10%. You want to buy an item of clothing you saw last week (before the price increase.) After you make a fuss about the price increase, the shopkeeper will give you a 10% reduction on the new price. Do you now pay more/less/the same as before the price increase? Help 3: 100    Use this scheme and think of how to calculate the final amount quickly.