

First draft of the STIPPS learning line concerning ‘scientific and technological process of thinking and acting

The learning line proposed in this paper finds its origin in the careful study literature concerning attainment targets (of primary education) and developmental objectives in science teaching. In this study, the attainment targets and developmental objectives are linked to the means of thinking (cognitive functions) as prescribed by Feuerstein.

These means of thinking are the prerequisites of thought in general. They form a kind of tool case with which man can understand the complexity of the world and with which he can find solutions to problems. These means of thinking are not innate, but can be developed.

We are convinced that an adequate application of the didactic model ‘the temple of scientific thinking’ in pre primary and primary education can successfully encourage and realise the development of the goals named below.

The learning line uses the following four codes:

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Children in this age group are introduced to activities focused on this aim. The teacher gives the initial impetus and goes more deeply into this goal whenever an opportunity occurs.

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Children gradually construct knowledge, insight, competences or attitudes, mentioned in this goal. The teacher makes sure that children experience new things and make conclusions in this matter. Afterwards, the children are given an opportunity to express these.

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Children should have obtained the goal in the indicated age group, they master it. This goal is explicitly and systematically worked upon.

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Children continue to integrate the obtained knowledge, insight and competences, they gain more in-depth knowledge and broaden their view in the matter. The teacher provides a variety of activities to ensure this process.

MEANS OF THINKING (cognitive functions)	jk	ok	1 ^e grade	2 nd grade	3d grade
Accurate and directed observation with all senses (AT World Orientation general competences)					
Listening, seeing, feeling, tasting, smelling	-----	-----	-----	+++++++	+++++++
Directed observation in function of a question (focus)	-----	-----	-----	-----	+++++++
Noticing and naming problems (AT learning to learn)					
Recognising and defining a problem	-----	-----	-----	-----	-----
Asking questions, of which the answers can be obtained	-----	-----	-----	-----	-----
Estimating the extent of the problem		-----	-----	-----	-----
Solving problems in a systematic way, full insight (AT learning to learn –AT Mathematics)					
Analysis of the problem		-----	-----	-----	-----
Strategic thinking (searching procedures, analysing problems into smaller parts, making suppositions). Determining a strategy to check suppositions (making suppositions, formulating searching procedures, analysing a problem, calculating roughly the result of a calculation, able to find estimating procedures when data is non-exact, ...)		-----	-----	-----	-----
Executing a plan (experiment, construction,...)	-----	-----	-----	-----	-----
Evaluating a solution (able to say why this is a fine solution)		-----	-----	-----	-----
Searching for logical argumentation (solution frames) – deductive and hypothetical thinking – avoiding trial and error (AT World Orientation: general competences - AT mathematics: strategies and problem-solving competences)					
Checking things spontaneously (eg. reflectively checking a hypothesis)			-----	-----	-----
Finding means to check and confirm a hypothesis					
Defining a solution frame (choosing a frame in which solutions can be sought)					
Scientific and technological thinking and acting (when starting up experiments)				-----	+++++++
Concluding independently from a number of suppositions (confronting observations to get to suppositions, combining suppositions to a conclusion)		-----	-----	-----	-----

Combining, making connections					
Formulating simple if-then-relations (cause and effect, seeing things and their connections)			-----	-----	-----
Linking everything which is learned as much as possible with the knowledge and competences already present		-----	-----	-----	-----
Projecting virtual relations (Making explicit and visible underlying connections)					
Precision (AT learning to learn – AT World Orientation: technology – DO pre-mathematics)					
Continuously being alert for minor differences					
Noticing the fact that certain features (of an object) are subject to change, while others remain unchanged (regardless of or independent of the spatial placing arrangement)					
Executing correctly (independently) a simple visually-presented plan	-----	-----	-----		
Choosing material and tools on the basis of a (possibly) self-made plan (drawing, experiment, manual) and using those to systematically execute a plan		-----	-----	-----	+++++++
Examine a self-made product or preparation (checking if this self-made product or concept meets predefined demands)	-----	-----			
Ameliorating a product/concept after evaluation	-----	-----	-----		
A need to be exact (need to formulate thoughts with sufficient detail)					
Taking initiative independently					
Planning (AT Learning to learn – AT mathematics)					
Slowing down one's impulsiveness (thinking before acting)					
Working according to plan (able to imagine the different steps to come to a solution)	-----	-----	-----	-----	-----
Checking upon oneself when executing a plan					
Knowing that there are sometimes several solutions to a problem (regarding numbers, measuring, geometry and spatial orientation) and that sometimes, these solutions depend on the way the problem is interpreted.					
Interpreting solutions and formulating provisional answers to the problems; afterwards testing and improving the different steps, and correcting and judging the answer as a whole: is it meaningful, does it contain any realistic value, ... ?					
Revising the plan when necessary (keep looking patiently)		-----	-----	-----	-----
Being prepared to ask oneself questions concerning the way of handling a mathematical					

problem during and after solving it, and being prepared to re-adjust it on the basis of this reflection.					
Reflecting as much as possible on the own learning process of the learning activity (why do I do this? Do I know now what I want to know? Why does it go wrong?)		-----	-----	-----	-----
(Independently and on their own level) searching, acquiring, using, retaining different sources of information in a systematical way (AT Learning to learn – AT mathematics: attitudes)					
Having the need to search for information via different sources					
When searching this information, able to make effective usage of <ul style="list-style-type: none"> - One's own knowledge - The knowledge of others (parents, teachers) - The object or phenomenon itself - Datafiles (catalogues indexes, list of headwords) 	_____	-----	-----	-----	-----
Systematic research (gradually collecting data, so that nothing gets lost)					
Selecting data, necessary to solve a problem, and disregarding all other information from an abundance of information					
Using two or more sources of information					
Developing a critical attitude towards all kinds of numerical data, tables, calculations (ab)used (un)consciously to inform, persuade, mislead people, etc.					
Spontaneously comparing behaviour (DO pre-mathematics - AT mathematics)					
Generating the need to compare things: considering resemblances and differences (of things, events, ...)	-----	-----	-----		
Able to put in order according to a selffound criterium	-----	-----	-----		
Able to put in order on the basis of at least one criterium	-----	-----	-----	_____	+++++++
Able to put in order according to colour, taste, form, smell, ...	-----	-----	-----	-----	-----
Able to put in order according to importance, (part of a) subject, space, ...	-----	-----	-----	-----	-----
Able to put in order according to collective features or qualities	-----	-----	-----	-----	-----
Able to put in order according to on the basis of a qualitative comparison		-----	-----	-----	_____
Observing resemblances and differences of objects/products regarding <ul style="list-style-type: none"> - colour, taste, sound, smell, form, touch, ... - strength, elasticity, hardness, absorption, ... - Length, surface, volume, mass, ... 	-----	-----	-----	-----	-----

(extending the repertory of criteria of resemblance)		-----	-----		
Able to measure length, surface, volume, mass, ...		-----	-----	-----	-----
Comparing one's own method to other methods and able to judge this		-----	-----	-----	+++++++
Expressing oneself as clear as possible and naming things correctly (AT education in mother tongue)					
Possessing words and terminology to describe objects, events, ways of thinking and experiences with precision (enlarging and developing vocabulary)		-----	-----	-----	-----
Expressing oneself understandably (placing oneself in somebody other's shoes so as to make one's answer clearer)					
Able to report on findings (visual transport)					
- Able to note down and reflect observations during research, demonstration, ...					
o In own words, in drawings, schemes		-----	-----	-----	-----
o More mathematical: in tables, graphics, formulas, diagrams				-----	-----
- Able to report on a task group				-----	-----