Project title: **The Inventors**

Work pack: **10**
Deliverable: **1**
No.: **1**
Description: **Evaluation Report**

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Contents

Introduction

My name is Tom Hutten and I am a student at the Fontys PABO in Tilburg, the Netherlands, where I am rounding off the main phase of my studies. In addition I am minoring in COK (Creative Investigating Child). Within the framework of a traineeship, as a Fontys student I was asked by the Stichting De Uitvinders [The Inventors] to evaluate the Comenius project of "The Inventors". I started in 2013 and rounded off my evaluation in September 2014.

The reason that I wanted to be involved in this project as a trainee is that I feel that too little attention is paid to teaching technology in primary education. That idea was the basis for my starting at "The Inventors", to see why there is so little interest in teaching technology. Prior to this project I had already carried out a small independent survey amongst primary school teachers that showed this. The teachers often indicated that it costs too much time and they themselves are really unacquainted with working with technology. In my opinion, the teachers have a lack of self-confidence and they do not dare to teach technical subjects in class. As a result of my personal interest I thought it was very interesting to experience how teachers got to work with the projects of The Inventors and what the results are.

To begin with I immersed myself in the project. I read the reports of teachers who participated in the project for an academic year. I then visited schools myself and made personal notes. In addition, I attended the teacher meetings that were held within the framework of the project. In the end I drew up a digital survey for both teachers and pupils. On the basis of all this data I drew a number of conclusions that I have recorded in this report.

All in all I think that the projects of The Inventors with their narrative context offer a very suitable and above all fun way of including technology in primary education in a curriculum that extends beyond one subject. I would like to remain involved in this project in the future. I am also convinced that now and in the future my fellow students will be happy to apply this method in teaching and be self-confident in class.

Mid-term review

See Annex A
Reports of schools were requested after the first year of participation. These reports are collected in Annex A

Evaluation and summary of the mid-term review

The Inventors have a number of stories with which they take different years in primary education on adventures; adventures that introduce technical challenges and assignments. I will describe the strengths and weaknesses of each adventure below.

The Inventors and the Wheel of the Sun

Weaknesses:

- The experiment with holding the plastic solar tower (Sunny and the Solar Tower) over a tealight is not very responsible since the plastic melts. Instead of a tealight it is better to use hot water.
- The price of the pack is relatively high since it contains precisely enough materials for 30 children. However this does not leave any room for errors. In addition, a lot of things still have to be collected and/or bought. It would furthermore look better if the cardboard box were replaced by a sturdier plastic box.
- The experiment with the lemon does not connect with the story and is relatively unreliable. What is more, the lemon has nothing to do with green energy, which is central to the story.

Strengths

- The explanation and animations of the worksheets; Sunny and the wind turbines, Sunny and the Solar Tower, The Journey, are carefully formulated and detailed. Each worksheet also contains a little bit of theory so that after completing the worksheets the children certainly know more about green energy.
- The film is well made and informative. All the subjects discussed fit in the subject of green/sustainable energy.

Summary of remarks and/or tips to improve the project:

- Remove the assignment with the lemon from the worksheets in connection with unreliability of the task and the fact that it does not really connect with the story.
- Expand the contents of the box of materials so that errors can be made. It is also better to pack the materials in a sturdier plastic box. (It could have the logo of "The Inventors" printed on it for example.)
- Remove the tealights in the experiment with solar tower (Sunny and the Solar Tower) from the worksheet and replace them by using hot water.

The Inventors and the Drowned River

Weaknesses:

- The experiment with the wing has to be carried out very accurately.

- The continuous bucket pump is very difficult to construct for the children due to the weakness of the materials used.

Strengths:
- The worksheets are worked out in detail.
- The children think the assignments of building the bridge, the continuous bucket pump, keeping a ball up with a straw and the experiment with the balloon are fun.

The Inventors in Africa

Weaknesses
- The wire that is used for the lizard and the shaker is very thick which makes it really difficult for the children to bend. The current thickness of the wire is 1 mm which should be changed to 0.5 mm so that it is easier to bend by the children.
- The sets of pliers that are provided contain 3 pliers including 1 pair of wire cutters. If different wire is opted for, the other two pairs of pliers are superfluous.
- The box does not contain any hammers, so that the toy hammers that are usually found at school are used. However they are not strong/heavy enough, to flatten the crown caps. A 450-gram hammer should suffice.
- The birch planks provided for the template of the lizard and the template of the shaker are much too hard. As a result, it is not possible for the children to hit nails into the wood. MDF boards would probably be more suitable because they are softer.

Strengths:
- The materials required are provided in the box and some of the materials (planks, crown caps and nails) can be reused.
- Teachers can apply their own opinion and ideas in this project.
- The worksheets are detailed and at the level of the target group selected.

- **Summary of remarks and/or tips to improve the project:**
- Replace the layered birch planks with MDF. MDF is softer so that it is easier to hit nails into it.
- Options for the hammers: 1. Provide hammers in the box.
  2. Make a note in the teacher worksheet so that instead of a toy hammer a hammer of at least 450 grams is used to flatten the crown caps.
- Replace the wire of the lizard with thinner wire. The thickness of the wire goes from 1.00 mm to 0.50 mm.
- Replace the set of pliers by one (perhaps slightly bigger) pair of wire cutters.

Primary school visits the Netherlands and Belgium:

In addition to the written evaluations and teacher meetings, I also visited schools.
During these visits, pupils and teachers were interviewed. Pictures of the project activities were taken. (Due to privacy rules this was only possible in consultation with and after approval from the school).

During the visits, lessons were analysed according to the method of van Gelder[1]; this includes:

- The pedagogical actions of the teacher.
- The responses of the pupils.
- The lesson schedule.
- The learning content of the lesson.
- Electronic and/or educational resources used in teaching.

After all the schools had been visited, the data was sorted by the following topics:

- - The hand-outs.
  - The input of the teacher.
  - The methodology in the classroom.
  - Errors in the project (based on the observations of the interviewer).
  - Errors in the project (based on the experiences of the participants: teachers and pupils).

[1] Van Gelder is a psychologist who designed lesson analyses in which the actions of the teacher are linked to the pupils.

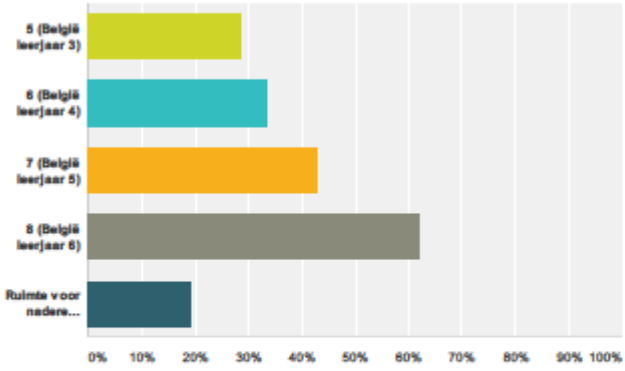
Digital surveys near the end of the project:

Annex C1 The Inventors Survey in the Netherlands, Belgium and Kenya

Enquête De Uitvinders

Q1 Deelnemende groep(en)

Beantwoord: 21 Overgeslagen: 0



Antwoordkeuzen	Reacties	
5 (België leerjaar 3)	28,57%	6
6 (België leerjaar 4)	33,33%	7
7 (België leerjaar 5)	42,86%	9
8 (België leerjaar 6)	61,90%	13
Ruimte voor nadere toelichting	19,05%	4
Totale aantal respondenten: 21		

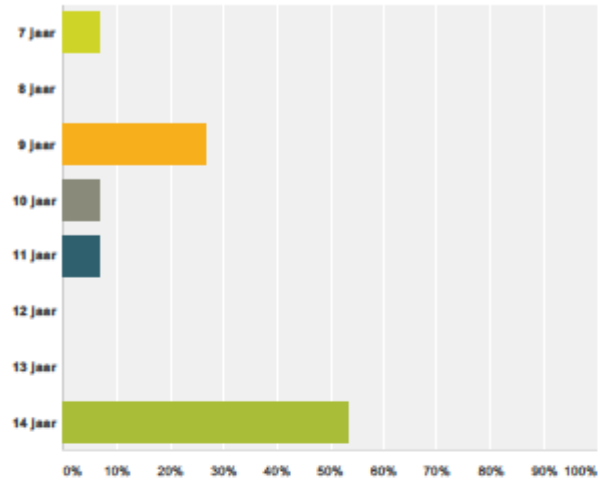
#	Ruimte voor nadere toelichting	Datum
1	Vso leerlingen 15 tot en met 19 jaar met verstandelijke beperking	10-7-2014 15:50
2	voortgezet speciaal onderwijs	26-6-2014 23:22
3	Plusgroep met deelnemers uit groep 5-8	21-6-2014 14:09
4	De kinderen zitten in een plusgroep met verschillende leerjaren samen	21-6-2014 10:33

Annex C2 The Inventors Survey for Kids in the Netherlands, Belgium and Kenya

De Uitvinders Kids

Q1 Hoe oud ben je?

Beantwoord: 15 Overgeslagen: 0



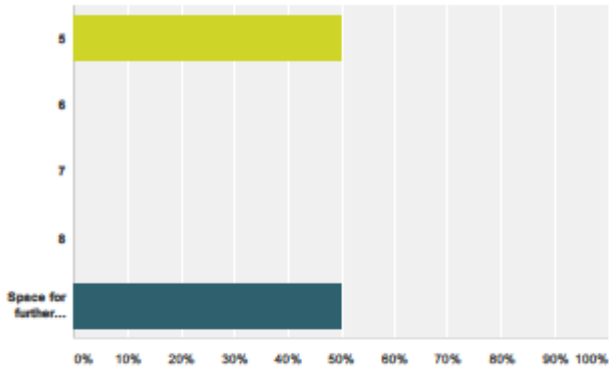
Antwoordkeuzen	Reacties	
7 jaar	6,67%	1
8 jaar	0,00%	0
9 jaar	26,67%	4
10 jaar	6,67%	1
11 jaar	6,67%	1
12 jaar	0,00%	0
13 jaar	0,00%	0
14 jaar	53,33%	8
Totaal		15

Annex C3 The Inventors Survey in Sweden

Survey The Inventors

Q1 Participating year(s)

Beantwoord: 2 Overgeslagen: 1



Antwoordkeuzen	Reacties	
5	50,00%	1
6	0,00%	0
7	0,00%	0
8	0,00%	0
Space for further explanation	50,00%	1
Totale aantal respondenten: 2		

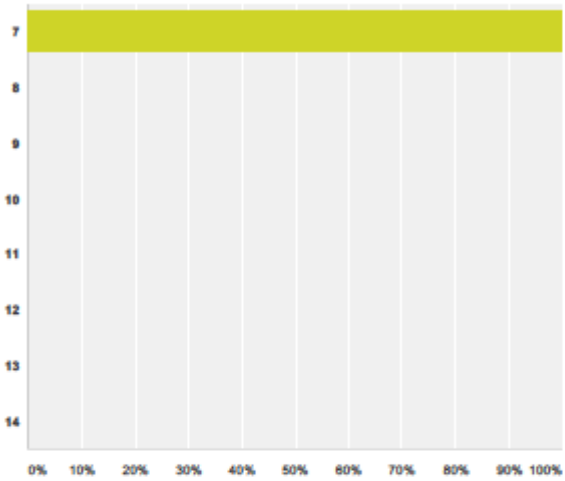
#	Space for further explanation	Datum
1	PYP4 - 8 and 9 years old	9-6-2014 14:48

Annex C4 The Inventors Survey for Kids in Sweden

Uppfinnarna kids

Q1 Hur gammal är du?

Beantwoord: 1 Overgeslagen: 0



Antwoordkeuzen	Reacties	
7	100,00%	1
8	0,00%	0
9	0,00%	0
10	0,00%	0
11	0,00%	0
12	0,00%	0
13	0,00%	0
14	0,00%	0
Totaal		1

Summary of topics in the teachers' survey :

Hand-outs:
The worksheets generally look good. The structure is clearly organised and the steps follow one another logically. The teachers indicate that the subject matter connects with the level of the target group.

The Inventors' Competition:
Teachers indicate that The Inventors' Competition is a lot of fun. However it is a lot of work for a teacher to manage the pupils' participation. The registration of the pupils' participation on the website and helping with the inventions is an awful lot of work. This is also an important reason why some teachers decide not to take part in The Inventors' Competition.

Communication:
Communication between The Inventors and the participating schools/partners is perfect. The website of The Inventors is used a lot by teachers and pupils. According to the teachers, pupils can easily work with it. The newsletters are also a good way to stay informed about the project. Schools indicate that no improvements are necessary in this respect.
There is no need for the Facebook page that was created to form a community of teachers that inform each other. Many schools have privacy rules that forbid the use of Facebook. That is why schools do not use the page.

Internationalization:
Both the teachers and pupils know that the project is international. However for both teachers and pupils this is not an additional motivation for taking part in the project. Pupils are only additionally motivated if they can take part in the 'international' finals which was the case in the first year of the project.

Entrepreneurship of children
The entrepreneurship of children above all manifests itself in The Inventors' Competition where children vote for their inventions. Working in a team also plays a major role since we see that the projects score well in the area of cooperation. We hear from teachers that children discover their own talents and want to develop them further within the team. Appreciation from the other pupils also plays a major role in this.

Summary of topics in the pupils' survey:

The difficulty of the tasks
The pupils indicate that they do not think the assignments are too difficult. They can be called challenging. Pupils get new subject matter and can link this to knowledge that has been previously acquired.

The Inventors' Competition
The pupils really enjoy The Inventors' Competition. They think it's a pity if their teacher decides not to participate in that part of the project.

The children's enjoyment of the project
The project is fun for both pupils who are good at technology and those who are not good at it. The pupils indicate this in the survey.

Content Evaluation

Tule and OVSG are organisations that have set core targets that pupils have to have met by the end of their primary school career. The core targets have been classified by minor subject and subtopic. The Core Targets that The Inventors claim to teach are certainly achieved during the project. The Inventors is a broad technology project. That is to say that The Inventors teaches not only technology but also other subjects such as language and maths. The Inventors offers the possibility of teaching these subjects in a different context.

CORE TARGETS NETHERLANDS (TULE.SLO)
Core Target 4 (Dutch): The pupils learn to find information in informative and instructive texts including diagrams, tables and digital sources.

Core Target 33 (Sums/Maths): The pupils learn to measure and calculate with other units and measures.

Core Target 35 (World Studies): The pupils learn to behave adequately in social situations.

Core Target 39 (World Studies): The pupils learn to handle the environment with care.

Core Target 42 (World Studies): The pupils learn to investigate materials and natural phenomena.

Core Target 44 (World Studies): The pupils learn to make connections between the effect, the shape and materials used of products in their own environment.

Core Target 45 (World Studies): The pupils learn to design solutions for technical problems, to execute and evaluate them.

Core Target 54 (Art Studies): The pupils learn to use images, language, music, games and movement, to express feelings and experiences with them and to communicate with them.

Core Target 55 (Art Studies): The pupils learn to reflect on their own work and that of others.

CORE TARGETS BELGIUM (OVSG)
Development Target 4 (ICT): The pupils can learn independently in a learning environment supported by ICT.

Development Target 5 (ICT): The pupils can use ICT to give shape to their own ideas creatively.

Development Target 6 (ICT): With the aid of ICT, the pupils can look up, process and save digital information intended for them.

Development Target 5 (Learning to learn): With or without support, the pupils can:
plan and organise their lessons, tasks and assignments;
check and adjust their own learning process.

Development Target 6 (Learning to learn): Attitudes and convictions. At their own level, pupils can learn:
accurately;
efficiently;
with the desire to be independent;
sufficiently self-confidently;
with an open mind;
whilst being critical.

Development Target 2.1 (World Studies – Technology): The pupils can say what materials or raw materials technical systems around them are made of.

Development Target 2.2 (World Studies – Technology): The pupils can investigate specific functions of parts of simple technical systems by means of using, assembling or disassembling them.

Development Target 2.3 (World Studies – Technology): The pupils can investigate why a technical system they have used themselves does not function properly.

Development Target 2.4 (World Studies – Technology): The pupils can illustrate that some technical systems have to be maintained.

Development Target 2.5 (World Studies – Technology): The pupils can illustrate that technical systems evolve and improve.

Development Target 2.6 (World Studies – Technology): The pupils can illustrate how technical systems are amongst other things based on knowledge of the properties of materials or of natural phenomena.

Development Target 2.7 (World Studies – Technology): The pupils can recognise the steps of the technical process in concrete experiences (defining the problem, developing solutions, making them, taking them into use, evaluating).

Development Target 2.8 (World Studies – Technology): The pupils can recognise technical systems, the technical process, tools and choices within different areas of application of technology.

Development Target 7 (Use of sources): The pupils can consult various different sources of information at their level.

Development Target 1.5 (Social skills): In group tasks, the pupils can lead the group or work under someone else's leadership.

Development Target 3 (Social skills): The pupils can collaborate with others, without making a distinction based on social background, gender or ethnic origin

Intended educational level

Note: In addition, the hand-outs were evaluated whether they correspond to their intended educational level: Accountability of educational material is mainly viewed based on the areas of development as researched by the Russian psychologist Vygotsky:

- The zone of direct education: *The pupils know the material offered here and gain no new knowledge. The lesson material is repeated.*
- This is not the case at all in the project of The Inventors: the assignments that the children carry out are challenging and are offered at the right level.

- The zone of site development: *The pupils do **not** know the material offered but are able to make connections with their prior knowledge and their environment.*
- This zone of development is the most applicable since the children in my opinion are challenged in the assignments but also call on knowledge that has been previously acquired.

- The panic zone*: The pupils do **not** know the offered material and are not able to make connections with their prior knowledge or their environment*
- This does not apply. The assignments that the children carry out are challenging but certainly not too easy or too difficult. This can be deduced from the way the children work. They are concentrated and work well on the assignments. So you can deduce from this that the assignments are sufficiently challenging and therefore not too difficult.

- Furthermore the hand-outs were assessed according to the following issues:
- Dyslexia. Dyslexia is a bottleneck in the project. During school visits, dyslectic children saw reading the story as an unpleasant experience. The accompanying film is an excellent solution to this problem however.
- Language backlog. Teachers indicate that the stories of The Inventors (i.e. the written stories) are difficult to read for children who suffer from difficulties with reading. The film is a great alternative for this.

Summary of The Inventors' Competition

The Inventors' Competition is the final part of The Inventors project. In this part the pupils present their inventions. The following topics of The Inventors' Competition were evaluated:

- Stimulation of social development:
  - Cooperative work:
  - The assignments that the children carry out are formulated in such a way that children can do them individually. However, there are also tasks for which the children work together to arrive at a solution, for example making the lizard (The Inventors in Africa, worksheet 3) in which children help each other to bend the wire.
  - Social skills:
  - This is above all dealt with in the 4th worksheet of each story (the competition worksheet). Here the children consult with each other about what kind of invention they want to make, with what purpose, etc. In my opinion there is no specific focus on the further development of the social emotional aspect, but it definitely does feature.
  - Competitiveness:
  - The Inventors' Competition is perfect for the competitive element. By voting on the website and gathering votes for their invention, the children feel that they are really participating in a competition. However, this also has disadvantages according to many teachers. During my school visits, I experienced that teachers consider the competitive element of the project unnecessary or bad for the development of the children. This is also one of the reasons why teachers sometimes do not participate in The Inventors' Competition. Another reason is that The Inventors' Competition takes too much time for the teacher to properly support it.

- Stimulation of the development of cognitive development:
  - The cognitive development of a child is the part of the development where concrete subjects are learned (Maths, Language, etc.). Everything a child does means it learns something new. Naturally this is also the case with The Inventors. Subject matter is offered of which children nothing to very little. For example the story of "The Inventors and the Wheel of the Sun". In it, different types of energy are named that children perhaps do not know yet. However, The Inventors is not really a project for primarily developing cognitive skills. The project is very suitable for offering previously gathered knowledge in a different context. You can above all see this during the do-assignments of the project.
- Stimulation of the development of motor development:
  - Fine motor skills. The fine motors skills are the small movements that an individual has to make to do something. For example, typing on a keyboard, bending wire (The Inventors in Africa) and other tasks. The Inventors offer more than enough tasks to stimulate the development of motor skills. This is apparent from the grades that the teachers give the assignments in the survey (See annexes C1, 2, 3 and 4).

- Presentation skills :
  - Presentation is still very new for children in the target group in question. During the project, not a great deal is done on presentation. However, if the children participate in the 4th worksheet of each story (The competition worksheet) it is another story. In this worksheet the children primarily have to work on presenting their "invention". It offers the children an opportunity to prove and explain why their invention is the best one.

Summary of communication

Communication with and between schools in the Netherlands, Belgium, Sweden and Kenya. To stay connected, the following media are used:

- The Facebook page of "The Inventors". https://www.facebook.com/groups/492250427507971/
- The website of "The Inventors".www.uitvinders-wedstrijd.nl / http://www.theinventors.eu/
- The teacher meetings.
- E-mail.
- Newsletters.

The following points were discussed and examined:

- The communicative value of The Inventors' Facebook page.
  - The Facebook page is not a successful means of communication for The Inventors. This can be deduced by the number of posts that were placed on the page. Teachers of this generation do not all have a Facebook account and do not feel the need to create one. Schools also have certain privacy rules which often also mean that nothing may be placed on the Internet. This is also indicated in the survey (Annexes C1, 2, 3 and 4).
- The quality of the communication between project management and participants:
  - Teachers indicated that the communication between The Inventors and the schools runs smoothly.
- Sufficient information on the website for participants:
  - The teachers indicate that they can find everything on the website.
- The frequency and content of the teacher meetings:
  - See annexes C1, 2, 3 and 4 for more details. The number of teacher meetings is considered more than enough. Many teachers find them useful to discuss their experiences and talk to teachers from other countries.
- The number of readers of the newsletter:
  - See annexes C1, 2, 3 and 4 for more details. The survey shows that many people read the newsletters and feel that they contain useful information.
- The communicative and substantive value of the newsletters:
  - See annexes C1, 2, 3 and 4 for more details. As indicated in the previous point, the teachers appreciate the information in the newsletters as additional information.
- The need for new ways of communicating:
  - See annexes C1, 2, 3 and 4 for more details. There is no need for aural means of communication. The teachers do indicate that working with Facebook is not a good option in connection with the regulations at primary schools that often do not permit access to Facebook or other social media for privacy reasons.

Summary of the working materials and tools provided

Each story has its own hand-outs and working materials and tools provided. The contents of these working material boxes differ for the specific stories and therefore tasks.

Although most of the materials are in the boxes, for some of these "inventions" materials must be brought from home. So what is asked about the boxes:

- Are the materials and tools sufficient?
  - The materials in the box are sufficient for the assignments for which they are intended. However, there is no room for a second chance because there is precisely enough material for each child. The teachers see this as a bottleneck since the materials are difficult to obtain if additional materials are required. Two of the three boxes of materials (The Inventors in Africa and The Inventors and the Drowned River) included a hairdryer. It often remains in the box because many schools already have a hairdryer. Perhaps it would be possible to make the hairdryer an optional part of the box of materials.
- Are the materials and tools applicable?
  - There are a number of points that can be improved with regard to the materials. I encountered the objections described below during the school visits. I also tried these things out for myself to see whether I encountered the same problems:

    The Inventors in Africa
  - The box of materials contains a number of sets of pliers. A set contains 3 different pliers. In principle you only need the wire cutters which makes the other pliers an unnecessary luxury. A sound pair of wire cutters instead of 3 lesser quality pliers would be a better solution.
  - The biggest problem with this project is the thickness of the wire provided. The children need the wire for two assignments in which they have to shape the wire (the lizard and the shaker). The wire provided is so thick that the children have trouble bending it. This reduces the children's fun since the task takes a long time as a result. A perfect solution would to take thinner wire (0.5 mm instead of 1.5 mm).

    The Inventors and the Drowned River
  - The continuous bucket pump is very difficult to build using the materials provided. This is because often the milk cartons are not sturdy enough. The assignment also frequently takes more time than planned.

    The Inventors and the Wheel of the Sun
  - The experiment with the lemons is unreliable. There is a 1 in 5 chance that the experiment will work since lemons are fairly susceptible to interference. Furthermore, the experiment is not really a good complement to the story.
  - In the experiment with the solar tower, a strip of aluminium has to be cut to make a rotor. The aluminium that is currently in the box is too thick to be cut by children. The candle that is placed in the solar tower is also dangerous. It melts the plastic bottle that forms the basis for the solar tower fairly easily. The recommendation is to use hot water for this.

Summary of Internationalization

There are different countries participating in the project "The Inventors". Every country gives its own substance to the project. The questions that are asked:

- Do the teachers notice the international aspects of the project?
  - The teachers know that the project is international. It offers them little added value. During the teacher meetings there is contact with other teachers.
- Are the pupils aware of the internationalization?
  - The pupils are aware that the project is also going on in other countries.
- If so, what could they achieve with this information?
  - For the pupils, the international aspect of the project offers little added value. This is because the pupils do not have any connection with the pupils from the other countries.

Summary of the promotion of creativity, innovation and entrepreneurship in children and youth

The most important goals are to promote creativity, innovation and entrepreneurship in children and youth. The questions asked are:

• Is the project apt to excite entrepreneurship in children?
The teaching material is built up in such a way that children are always asked about the knowledge they already have. Then they are challenged to arrive at creative solutions themselves. It is not until after that that new knowledge is discussed within the context of the story. As a result, above all the children's creative and innovative talents are stimulated.
During the 4th worksheet, a large amount of entrepreneurship is added to this. Children now have to defend and praise their own work. They are challenged to come up with original ideas which stimulates the creativity. After all, they are working on praising their invention, looking for materials for their invention as well as other subjects.

• What tools are therefore offered?
The worksheets and The Inventors' Competition are offered to stimulate innovation and entrepreneurship in children. Above all the website is a very suitable tool because pupils can present themselves there and gather votes for their invention.

• Is it possible to measure or test creativity and if so how?
Creativity in children is difficult to measure since there are no measuring units available to do so. One method is to assess this is to consider whether a child can think in a problem-solving way. In doing so, they also take the next creative steps. As a result of The Inventors worksheets, the children work in a creatively investigating way. By this I mean that the children can solve the problems they encounter whilst carrying out the assignment.

• To what extent does the manner of implementation of the Inventors' Competition have an impact on the creativity of the children (group work, the children can form their own teams, etc.)? The children have to invent something themselves in The Inventors' Competition. Creativity plays a major role in this. By thinking outside the box, the children get to work on their own inventions. The children's creativity is easier to assess in the competition than in other parts of the project. If children are allowed to form their own teams, we often see a natural process in which children complement their talents with the capacities they lack and recognise in their classmates.

Conclusions of the evaluator

I found my traineeship period with The Inventors Project very instructive. As a (future) teacher I am completely behind the projects of The Inventors. The main reason is that in my opinion The Inventors is unique in its method. The narrative way of teaching and the creative investigative way of learning are the biggest selling points of The Inventors projects. After all, this is what distinguishes them from the other technology projects (that I know of). As already named in the evaluation, there are a number of points for improvement. However, they have very little to do with the organisation and content of the project. The points for improvement primarily concern time management, planning and the choice of materials. (See: Evaluation and summarization of mid-term review.)

What is also an important success factor of the project is the project organisation. I have worked and/or completed traineeships at various educational companies. My experiences at The Inventors are particularly positive because the creative, the corporate and the organisational qualities are well represented by the various people within the project organisation. In addition, the employees work together very well.

In summary I would like to say that "The Inventors" is a wonderful project for the last four years of primary school [groups 5, 6, 7 and 8] (and hopefully in the future more groups). Stimulating children's creativity is an important element and the children experience it as a lot of fun. In addition, various domains can be linked to The Inventors so that the projects can also be applied as stimulating topics across subjects in education.

I'm really looking forward to more exciting stories by "The Inventors".

Tom Hutten