PHERECLOS

PARTNERSHIPS FOR PATHWAYS TO HIGHER EDUCATION AND SCIENCE ENGAGEMENT IN REGIONAL CLUSTERS OF OPEN SCHOOLING

7.3

Teacher Training Innovation Toolkit on Open Schooling

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824630.

Project Details

Acronym:	**PHERECLOS**
Title:	PARTNERSHIPS FOR PATHWAYS TO HIGHER EDUCATION AND SCIENCE ENGAGEMENT IN REGIONAL CLUSTERS OF OPEN SCHOOLING
Coordinator:	**KINDERBURO UNIVERSITAT WIEN GMBH (KUW)**, Austria
Reference:	824630
Type:	Coordination and Support Action (CSA)
Program:	HORIZON 2020
Theme:	Open schooling and collaboration on science education
Topic-ID:	Topic SwafS-01-2018-2019
Start:	01 October 2019 – 30 September 2022
Duration:	36 months
Website:	www.phereclos.eu
Consortium:	**KINDERBURO UNIVERSITAT WIEN GMBH (KUW)**, Austria **SYNYO GMBH (SYNYO)**, Austria **UNIVERSITAET INNSBRUCK (UIBK)**, Austria **UNIWERSYTET SLASKI (UNI SLASKI),** Poland **UNIVERSITAT WIEN (UNIVIE)**, Austria **EUROPEAN SCHOOL HEADS ASSOCIATION (ESHA)**, Netherlands **KOBENHAVNS UNIVERSITET (UCPH)**, Denmark **STICHTING INTERNATIONAL PARENTS ALLIANCE (IPA)**, Netherlands **SNELLMAN-INSTITUUTTI RY (SNELLMAN)**, Finland **POLITECHNIKA LODZKA (TUL)**, Poland **UNIVERSIDADE DO PORTO (UPORTO)**, Portugal **S.I.S.S.A. MEDIALAB SRL (MEDIALAB)**, Italy **UNIVERSIDAD EAFIT (EAFIT),** Colombia **ASOCIATIA UNIVERSITATEA COPIILOR (UNICO)**, Romania **TEACHER SCIENTIST NETWORK LBG (TSN)**, United Kingdom

Deliverable Details

Number:	**7.3**
Title:	**Teacher Training Innovation Toolkit on Open Schooling**
Lead beneficiary:	UCPH
Work package:	WP
Dissemination level:	PU (Public)
Nature:	(O) Demonstrator
Due date:	30/7/2022
Submission date:	**8/7/2022**
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Version History:

Date	Version No.	Author	Notes	Pages (no.)
30.6.22	0.1	UCPH	draft for review	88
7.7.22	0.2	UCPH	second draft version	83
7.7.22	0.3	UCPH	Final draft	82
8.7.22	0.4	UCPH	Final version	82

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Executive summary

In the PHERECLOS project, there has been a strong focus on building local sustainable collaboration structures for developing and practicing Open Schooling.

Being on this transitional mission in very diverse demographic settings, there has also been a need for developing a number of supporting tools and aiding structures. This goes for the work in the three-year project period and just as much for setting sails into the post project period/implementation phase.

One of the findings from the Local educational Clusters (LEC) is that the teachers are key persons for a transition towards sustainable Open Schooling. Hence, a Toolkit to support the teacher position in Open Schooling development is in its place.

This toolkit is in the practice-oriented end of the spectrum and is aiming to be able to support the teacher's role going into Open Schooling collaboration projects. From the beginning of seeking potential external partners, until the project turns into ongoing activities.

The structure of the Toolkit is as a timeline where it passes through,

- concept development
- planning of activities and establishment of external partner network
- execution of Open Schooling activities
- evaluation of the Open Schooling collaboration
- mainstreaming into a sustainable ongoing Open Schooling program

To support these core elements in Open Schooling from a teacher's perspective, we present seven training activities that could also be a part of a real life collaborative development of activities. PHERECLOS learning values are, among others, based on STEAM, 21st century skills and inclusive education in a local educational environment. Where there are plenty of innovative learning methods to choose, there can be a lack of a common understanding of the language around these methods. The Toolkit suggests a terminology that can operationalised into learning processes in Open Schooling.

The Teacher Training Toolkit on Innovation in Open Schooling is one of several PHERECLOS supporting structures and papers to facilitate a local and sustainable transition of the educational systems into Open Schooling as a natural part of the educational landscape, from bottom up and top down at the same time.

Introduction

The purpose of the Teacher Training Innovation Toolkit on Open Schooling is to deliver a near practice-oriented handbook that will support teacher trainers and institutions that work with teacher training students and in-service teachers in the development of out of school and Open Schooling activities integrated in a school-based context.

The Toolkit based on the notion of learning-by-doing, offers an approach that makes it possible for practitioners to implement Open Schooling programs with one of its clear aims being teacher training. The guide will help school leaders and trainers external to the school to consciously use the implementation of Open Schooling as an innovative approach to training. Another innovative element is the co-training of professionals already working at schools and their future colleagues, the pre-service teachers. The Toolkit may also inform the university training of future teachers, offering an innovative approach to compulsory professional practice hours/periods.

The aim of the innovation toolkit is to help schools move beyond a project-based approach towards a sustainable mainstreamed approach to Open Schooling. The educational focus will be oriented on transformative learning approaches within the field of STEM and STEAM (Liao, 2016). In this way learning goes beyond simply acquiring knowledge, to supporting pupils to find meaning in their understanding from 'living their learning'.

The toolkit will be partly based on the experiences of case studies from the PHERECLOS Local Education Clusters, LEC (WP3), Transnational Educational Mentoring Partnerships, TEMP (WP4) and Inspiring practices (WP2) to work with Open Schooling in different contexts and educational cultures.

Teacher trainers will be able to use the toolkit as a stepwise progress in training teacher students or in-service teachers to engage with Open Schooling activities as an active change agent in their local school and surrounding community. The toolkit is constructed as a timeline that guides the reader/user through succeeding phases of

- concept development
- planning of activities and establishment of external partner network
- execution of Open Schooling activities
- evaluation of the Open Schooling collaboration
- mainstreaming into a sustainable ongoing Open Schooling program

Open Schooling - why would you as a teacher get involved?

When the classroom is taken outside school, or the society outside school is invited into the classroom, there is a great potential to develop the formal teaching environment with informal learning situated in authentic and relevant settings. The informal learning situations can bring the pupils in school and the community closer together and add authenticity, sensory impressions and variation to the learning situations (Dansk Evalueringsinstitut, 2018). Regardless of the setting, the Open Schooling partner and preferred methodology, the focus should always be on creating the best possible framework for the pupils' learning and education.

In terms of teaching in the field of STE(A)M, the integration of Open Schooling has the potential for opening up work with authentic issues and hopefully increase engagement, motivation and ownership of the process.

Regardless of whether you are inviting pupils to help solve a real-life problem, investigate an authentic scenario, or just delve into an interesting question, Open Schooling demands different learning approaches than a classic transmissive teacher-led learning strategy.

Introducing creative and innovative methods from the project-based learning toolbox to STEM will make it possible to move the education towards a more learner-centred approach. With this move, comes pedagogical challenges.

As a teacher trainer, in-service teacher or a teacher team, with a certain amount of autonomy in creating curriculum and/or choosing methodology for the pupils, it should be possible to create motivating Open Schooling activities by using this Toolkit.

A change in methodology demands a lot of training, experimenting and motivation to try and sometimes fail, before success becomes frequent. This goes for all that are involved.

Someone once said that in order to master a new skill, most often there will be a "stinking" phase of undefined length prior to the mastering. Embrace the frustrating "stinking" phase and remember it is only a phase. If the "stinking" phase or rephrased, *the courage to fail*, shall become part of the learning process, there needs to be established an environment where the motivation to develop competencies, knowledge and skills is more, or just as, important as achieving high marks and grades and participants who are not afraid to fail.

This toolkit is developed as a part of the outcomes from the EU Horizon 2020 project **PHERECLOS** , which is built around three particular concepts as the main pillars:

- **The concept of Science Capital**, which perceives individual representation of science as a bundle of commonplace habits, expectations and attitudes which are directly linked to and influenced by the everyday social sphere of individuals and all social actors herein.
- **The concept of Children's Universities (CUs)**, which stands for non-formal university-based science engagement programs for children and young people as unconventional and non-traditional recipients of academia.
- **The understanding of an Open School culture**, in which schools reflect on external ideas, topics and challenges and incorporate them in their teaching approaches and everyday school life, and in return, provide the creativity and potential as the assets of their pupils and teachers to the community around them, thus opening the school both literally and figuratively.

These core values are also be influencing the content and methods found in the Toolkit.

Develop your concept for Open Schooling

The concept for how to collaborate with partners outside the school will be pointing out the direction for where you are heading. An Open Schooling team may start as a teacher team, but will often expand to involve representatives from other stakeholder groups. It could include external partners from informal learning environments in the local community, parents and civil servants from the local town hall. Maybe you are the one being invited into an Open Schooling implementation team that is being hosted by a local hub organisation.

Your role as a teacher is key and the role of teachers comprises both leaders of learning as well as capacity building for children. As experts regarding the every-day school life, teachers are the engines of adjustments, and therefore crucial for the development of Open Schooling concepts. However, the innovation potential for Open Schooling also lies within the diversity of partners in the Open Schooling team.

Start with a Reflection process - guiding questions

In order to develop a concept for open school practice in your school, community or municipality, it will often be necessary to step back and assess the educational ecosystem you are about to explore for collaboration possibilities. For this preliminary task, there can be relevant tools to use in order to make the best early decisions based on as much relevant knowledge as possible.

The realisation and reflection process that precedes the concrete planning phase when there is a decision to make about an Open Schooling collaboration can be helped by asking some important clarification questions within the team of teachers embarking upon the planning for Open Schooling.

First, there are some very basic reflection questions to consider and to start the discussions on why, how, what and with what before you engage with external partnerships in Open Schooling:

What is the purpose of Open Schooling activities for your school?

Is it clear and defined? By whom? Why?

What will be the benefit from different perspectives?

Has there been any reflection on the potential of external partners, and informal learning environments? What is the benefit, seen from the perspective of the teacher, school leader or pupils?

Who can be possible cooperation partners inside and outside the school?

What is the local potential? Who does what for whom and why? See the suggestion below for a mapping tool and use the training activity to create a common understanding of your local possibilities. Also, be aware of the potential resources within the school grounds. For example, the janitors are key collaborators if pupils decide to create a recycling campaign in their school. Everybody needs to feel a sense of ownership of the proposed activities.

Map local resources and potential network for Open Schooling collaborations

The digital tools of customised shared online maps are under constant development. Hence, it is beyond the purpose of this toolkit to point out what exact application to use. However, there lies a great collaboration potential for mapping opportunities of Open Schooling partners and locations in the defined local area, since the access to knowledge for new teachers in Open Schooling settings is a potential barrier for action. This also makes it more logistically easy for partners to meet and to engage (although some may be prepared to travel).

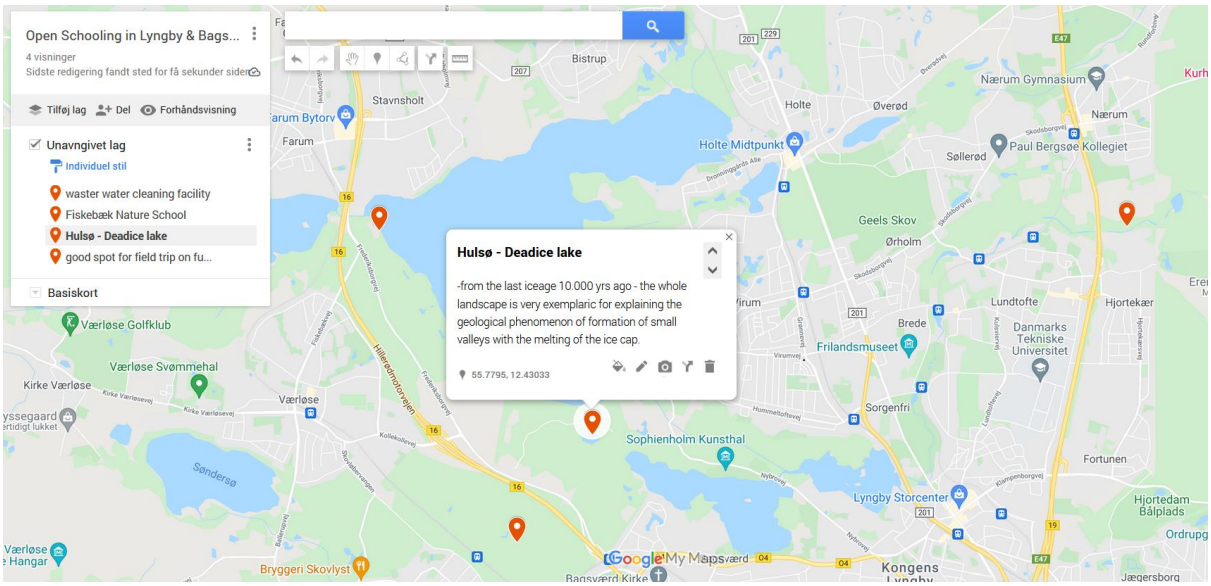


FIGURE 1. EXAMPLE OF A SHARED ONLINE MAP FOR POINTING OUT RESOURCES FOR OPEN SCHOOLING

My map feature in Google maps or similar can be very helpful for sharing knowledge of locations and institutions relevant for Open Schooling. In the map above four locations/institutions have been mapped with an orange colour marker. Cultural institutions, businesses and companies working with OS, NGOs, community organisations and members, sports and youth organisations could be included. See the actual map in Google here

A collective understanding of the possibilities and resources that lies within reach of a learning institution is an important element in creating a sustainable integration of Open Schooling in the curriculum. The Training activity describes how to facilitate a process that will bring a group of educators closer to a common understanding by mapping potential Open Schooling partners together.

What could be possible Open Schooling activities to support the aims and goals for learning?

Having mapped the potential partners, the next step could be to speculate on what learning activities they would be able to support. Engage your group creativity by this brainstorm activity.

Creating a catalogue of ideas for more detailed development will happen later in the planning process. It could be suggestions like: working with specified UN sustainable development goals, design challenges, experiential learning on certain subjects, mentor/expert visits, visit parents at workplaces, field trips, school-business collaborations, school-higher education collaborations, engaging in local NGO work, etc.

What benefits and challenges could an external partner have from cooperating with a school?

Imagine that you were in their shoes, what would the potential benefits, and also the extra work and potential barriers be?

How can I/we as a teacher team build good relations/network to partners outside the school?

Who should be the contact person, who will reach out, should we involve the school head, parents, or others? How could we establish a sustainable cooperation?

Plan your Open Schooling activity

With a thorough Open Schooling plan, you are already halfway there. In this Toolkit, a simple planning method - including so-called SMART goal setting - is suggested. It contains a minimum of steps in order to analyse, create choices, reflect and make decisions in order to establish a profound plan that helps to implement a successful Open Schooling project.

This section will also introduce

- a method for setting up and conducting participative and meaningful meetings,
- how to develop educational material from scientific articles and scholarly knowledge,
- the relevance and incorporation of 21st century skills,
- innovation competence as practice oriented elements in STEAM,
- different types of activities to navigate in, with emphasis on,
    - how to work with design challenges,
    - creating inquiry-based science activities,
- an Open Schooling assessment tool to validate the core elements of the activity

What is an Implementation Plan in terms of Open Schooling and why is it important to have one?

If you should find yourself as the Open Schooling lead in your school or local community and have a need for creating sustainable plans, an implementation plan could be useful. Such a plan helps to be clear right in the beginning about what needs to be done to achieve certain goals. Even if it may seem to some that it takes a lot of effort to create an implementation plan (according to the motto: "Plans are never kept anyway"), implementation research shows that the creation of such plans are very helpful in order to actually make things happen like intended.

An implementation plan includes goals, target groups, as well as a description of the planned Open Schooling practice and its context. In an Open Schooling context, there can be several target groups to consider, like fellow colleagues, external partners, different age groups of pupils, etc. Define the relevant target group(s) for your specific Open Schooling plan. Then think about the goals that you would like to achieve for each target group. You need to know the major goals leading towards the “big picture”, but also the smaller, more specific, ones that are necessary to get there.

Furthermore, an implementation plan contains considerations on how the goals can be achieved. What concrete measures or activities would need to be implemented to achieve these goals? List them for each goal! Then check again, whether the implementation of all these measures or activities is realistic or whether, perhaps one or the other measure, or even a certain goal must be dropped.

Next, a description of all planned activities is needed: When will the activity take place (schedule)? Who is involved? Who should be responsible? What (e.g. material) is needed for conducting this activity)? What is our timeline? A GANTT Diagram might be helpful for visualisation.

Finally yet importantly, it is also helpful to think about the context in which the Open Schooling project will take place. On the one hand, the "inner context" (i.e. the school, the teachers and pupils involved) will have an influence on the implementation (i.e. how motivated they are, how open towards Open Schooling, what resources are available). Second, the "outer context" also influences implementation (e.g., which organisations should be involved? What is the motivational situation here? How competent are they in dealing with pupils?)

There can be several unforeseen bumps on the road of developing new practices. Especially if the national or regional school legislation is hindering a transition towards innovative Open Schooling. Some of the challenges are addressed and handled in the SMART implementation planning in the next section.

Furthermore, here is a list of PHERECLOS papers and tools that could support the work on these considerations in teacher training and of course in actual Open Schooling planning,

- PHERECLOS policy briefs. The purpose of the policy briefs are as guides to different stakeholders connected to or interested in Open Schooling integrated in education,
- a policy and school system inventory over several countries school legislation and structure
- The PHERECLOS overall paper structure where you can find all the paper and tools developed in the PHERECLOS Project period,

To sum up: An implementation plan has the function of a "step-by-step" guide to making changes in practice – it should be realistic, feasible and concrete. Ideally, it is developed with all stakeholders and updated as needed. To develop a good implementation plan, it is necessary to answer some important questions (see Table 1).

Some advice before you begin

- Never do an Open Schooling project on your own (at least with one other teacher; reasons: more "power", sustainability in school/outside school more reasonable)
- Involve external partners as soon as possible and again, more than one per organisation; start with one partner in the beginning.
- Consider the role the external partners could/should have, especially regarding their pedagogical competencies (e.g., museums have qualified staff, greenhouse farmers may not).
- Create a sustainable team structure: Think about a good group size (3-7 persons is recommended) and composition of the Open Schooling implementation team, ensure a diversity of perspectives, talk about terms of reference and leadership.
- Spend time building trust between new partners.

TABLE 1. QUESTIONS AND STEPS FOR CREATING AN IMPLEMENTATION PLAN

What do we want to achieve? Who is important for this? Whom do we need?
Step 1. Determine goals and target groups What is our big aim, what do we want to change? To whom is the change relevant? What should our target groups know/think/do afterwards? Then formulate **SMART** goals for each target group. This acronym stands for: **S**pecificity: Describe a clear and concrete goal. It should be observable, such as a particular action or procedure. It is also recommended to define the magnitude by denoting the result with a number, amount, or percentage (e.g., 90% of the pupils should acquire XY). A specific goal answers the six 'W' questions: ● What do we want to accomplish? ● Who is involved? ● Where are we going to do it? ● When is it going to happen? ● What parts of the goal are essential? ● Why do we want to achieve this goal? **M**easurable: The outcome of the goal should be measurable – that allows you to ascertain to what extent the goal has been achieved.

Achievable: The goal should be acceptable to the people who will have to set about achieving it.

Realistic: The goal should be realistic – otherwise it will not motivate people. However, be aware: a goal that is too easy will not challenge people. Therefore, it is best to set goals that are just above the level of the person or organisation.

Time bound efforts: A goal should have a clear starting date and finishing date.

What are the main characteristics of the target groups of partners?

Step 2. Analyse target groups

It is important to get a clear picture of the characteristics and situation of the different target groups.

- What interest does the target group have in working with schools and children?

- What does the target group know about Open Schooling practice?

- What may the target group think of the change?

- What motivations are involved?

Such an analysis can be helpful in ensuring that the goals and measures/activities are well aligned with the target groups. Sometimes there will also be a need for “preliminary activities”: For example, if your perception is that parents are sceptical of one specific Open Schooling activity, consider strategies to potentially address those concerns. Put that also in your “list of activities'' - then you do not forget about this.

What are the main characteristics of the Open Schooling practice that should be implemented?

Step 3. Analyse your Open Schooling practice

What are the main components of the Open Schooling practice you would like to implement? What activities are associated with it? Is there any evidence that these activities will be helpful to achieve your intended goals? What staff, which organisations are required?

Look at your Open Schooling practice critically. Consider in advance its strengths and weaknesses. This may vary depending on the type of your collaboration partner.

What are the characteristics of the context?

Step 4. Analyse the context

Determine as concrete as possible what factors in the inner context (e.g. the school), but also outer context (e.g., the organisations involved, the surrounding community) will influence implementation of the Open Schooling practice.

There may be circumstances that inhibit or facilitate/accelerate implementation.

Pay attention to the social contexts and the relationships between individuals involved.

Consider the "logic" of the organisation(s) in which you plan to collaborate with. How do the decision-making processes work in this organisation(s)? What leadership style is predominant? Also, consider the economic and financial factors.

How to implement the Open Schooling practice?

Step 5. Choose suitable activities

Determine your concrete measures/activities that need to be implemented to achieve your goals. List them for each goal. Then check again, whether the implementation of all these measures/activities are realistic or whether, one or the other measure/activity, or even a certain goal must be dropped.

Know time, tasks and responsibilities, and costs

For each activity, determine when it will be done. Also, consider who must be involved and will make sure it happens. This is also a good time to check the feasibility of your plans. For example, check to see if the costs match the available budget. Check also whether the plans are feasible in terms of time. Adjust your plans if necessary.

Meetings

Do not forget to define a meeting process: It is recommended to form an Open Schooling team. This team should have regular, consistent meeting times and follow collaboratively developed meeting procedures that enable members to utilise meetings effectively and achieve planned objectives (look also at the section for inclusive meeting practice)

Plan enough time to reflect during the Implementation phase within your Open Schooling team. Discussions should be on: How do we succeed? What is (not) working ? What did we learn? What/how can we improve the implementation of the Open Schooling project? What should be adapted?

How to reach the target group(s)?

Step 6. Communicate and establish an Open Schooling team

Summarise the results of your consideration in a few meaningful sentences - the core message. Do this for each target group. The message tells what you want to achieve, with whom and in what way. Writing down such a core message forces you to articulate your plans clearly. At the same time, consider how you can best convey this message. What messages and words might help to attract the target audience?

An example for a core message could be:

Through the Open Schooling project "Greek mythology meets German biodiversity issues" (see Practice Open Schooling example), students will address dilemmas that may arise in the context of achieving the SDGs."

In Implementation Science, there is sound evidence that establishing implementation teams, i.e. a group of people who have oversight of the project and guide or manage the implementation process, is very useful. Who should be part of your Open Schooling implementation team? How can you go about recruiting these people as members of the team? What could be convincing arguments?

This table is based on and inspired by a step-by-step plan provided by ZonMV

Establish network - and professionalise your meetings

Inclusive meeting practices

A good teacher colleague once said, "*Too many people are attending too many meetings, where nothing is decided*". The experience of feeling stuck in a meeting is not the best way to foster collaborative innovation. Hence, an action oriented and inclusive meeting structure will minimise the risk of 'leaving participants behind'. A simple meeting agenda planner, named *I Do ARRT*, can help in hosting meetings where the intention, desired outcome, agenda, rules & roles, and time plan are transparent and decided together.

The action plan could be like this:

- Identify a meeting facilitator, with nothing at stake but to facilitate the first encounters
- Make the final agenda in collaboration with the other meeting participants as the first part of the meeting, to involve everybody in the process from the beginning (the method of I DO ARRT is a possible tool)
    - I - Intention of the meeting
    - Do - Desired outcome
    - A - agenda of the meeting
    - RR - rules and roles for the meeting and the participants
    - T - time plan - how much time should the different topics on the agenda be granted
- make sure to hear everyone out on expectations of the meeting and the outcomes, so they can be adjusted before commencing
- Make clear decisions and agreements, so that no one walks away with uncertainty of what the plan is, who is going to do what, and when.
- Again, avoid planning meetings where nothing will be decided. People's lives are too short for this.

Inspiration from https://kaospilotradar.dk/2018/03/06/i-do-arrt-making-meetings-great-again/ (accessed May 2022*)*

Develop authentic learning cases with external Open Schooling partners

In an Open Schooling collaboration, e.g. with a local company or public institution, the benefit of a meeting with the external partner provides the added value of authenticity, special equipment, physical settings and/or professional expert knowledge. However, there is also a dilemma between authenticity and didactisation. If no didactisation precedes the visit, there is a risk that the pupils will not understand what they experience in the meeting with the external partner. On the other hand, too much didactisation risks removing the authenticity, and the difference in settings compared to a normal school day may vanish (Høiby et. al 2020). Therefore, the teachers' professional role of being the liaison is critical. It cannot be expected that the external partner fully or partly to take on this responsibility, unless they are trained in education and pedagogy. Here, a professional sharing and agreement of roles between teacher and external partner needs to be evident (a true partnership).

Didactical transposition of expert and scholarly knowledge to knowledge taught in school

Whether the collaboration in Open Schooling is with higher educational institutions, museums or local companies, there will be a need to think about how the content is taught appropriate to the age and ability of the students. This must involve the teacher.

Professional and scientific knowledge addressing authentic problems are of great interest in an Open Schooling context. In order for the above mentioned to make sense to a younger target group it is important to adjust the level of complexity in order to become relevant content for their preconditions and the aims of the activity. You can say that there can be a need for deconstructing the content and reconstructing it to fit the pupils' learning situation (Achiam 2014). The challenge here is to conserve the original authenticity in the process and support the pre-understanding by scaffolding the pupils' knowledge about the matter.

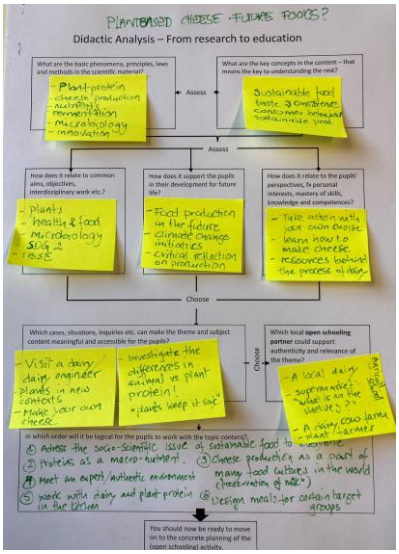


FIGURE 2. EXAMPLE OF A DIDACTIC ANALYSIS FROM SCIENCE RESEARCH TO CLASSROOM.

[Activity 2: Make "grown up" science accessible for Open Schooling]

This activity is designed to develop the required competencies to create authentic Open Schooling STE(A)M themes for learning. The didactic analysis presented in the activity, is supposed to bridge the gap from scholarly knowledge in academia or in professions to taught knowledge in the educational system. Normally this transposition, or transformation, is done through learning material companies, but you may find yourself in a situation, where nothing really fits the specific needs in this particular Open Schooling partnership.

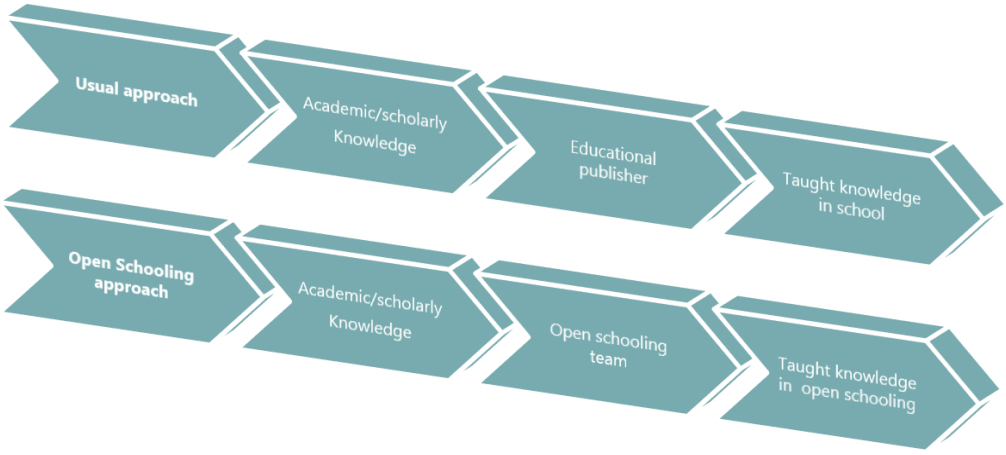


FIGURE 3. A MODEL FOR THE TRANSPOSITION FROM SCHOLARLY KNOWLEDGE TO TAUGHT KNOWLEDGE (INSPIRED BY ACHIAM, 2014)

The activity helps teachers and professionals from academia and industry to translate contemporary science topics into more usable educational materials that can be accessed by pupils.

Design and facilitate Open Schooling activities with innovative methods

In the toolbox of methods for creating innovative learning activities, it can be difficult to navigate. Simply because there are so many tools and methods, and they do not necessarily differ very much. However, there are differences in approach and in the end; they are all models that can be changed to fit the needs of your specific Open Schooling team. In this section, we will present different innovative approaches with a strong focus on operationalising the ideas of e.g. STE(A)M, 21st century skills and innovation competencies into practice. The intention is also to implement an inclusive and participative approach, simply by focusing on a more learner-centred practice design (Concina, 2019).

A common professional language is the foundation for collaboration in innovation

It makes good sense to establish a common language to attain a common understanding of the didactics that form the platform for working with STE(A)M, creativity and innovation inside and outside of the school.

KlimaZirkus (part of the PHERECLOS project) has developed a project-based learning didactic framework based on SDG's, STEAM and 21st century skills that we introduce here as a possible general design and assessment tool in learner-centred Open Schooling activities.

The models presented go beyond the project based learning (PBL) approach and can be introduced as assessment models in short term innovative STE(A)M activities such as inquiry-based science education, problem based learning and design/engineering challenges.

It is a fact that in education, time is a valuable resource and you do not always have a month available for a full project based learning activity, containing Open Schooling collaborations. Hence, short-term alternatives will also be suggested.

Planning participatory oriented STE(A)M

Elements from PBL can be used for reflections on a learning design process, as well as a practical guide for working with pupils in an innovative, learner-centred and formative assessment oriented way.

The Klimazirkus reflection guides for planning activities are presented as an example of important steps to consider in the design and facilitation of innovative pupil driven learning processes.

The 4C compass - navigation in 21st century skills

In practice, the '4C' competencies, regarded as 21st century skills are also essential for STE(A)M. The headline skills are collaboration, creativity, critical thinking and communication. They are all key elements in the process of becoming competent citizens in the society around us and should therefore be part of the educational strategy in school.

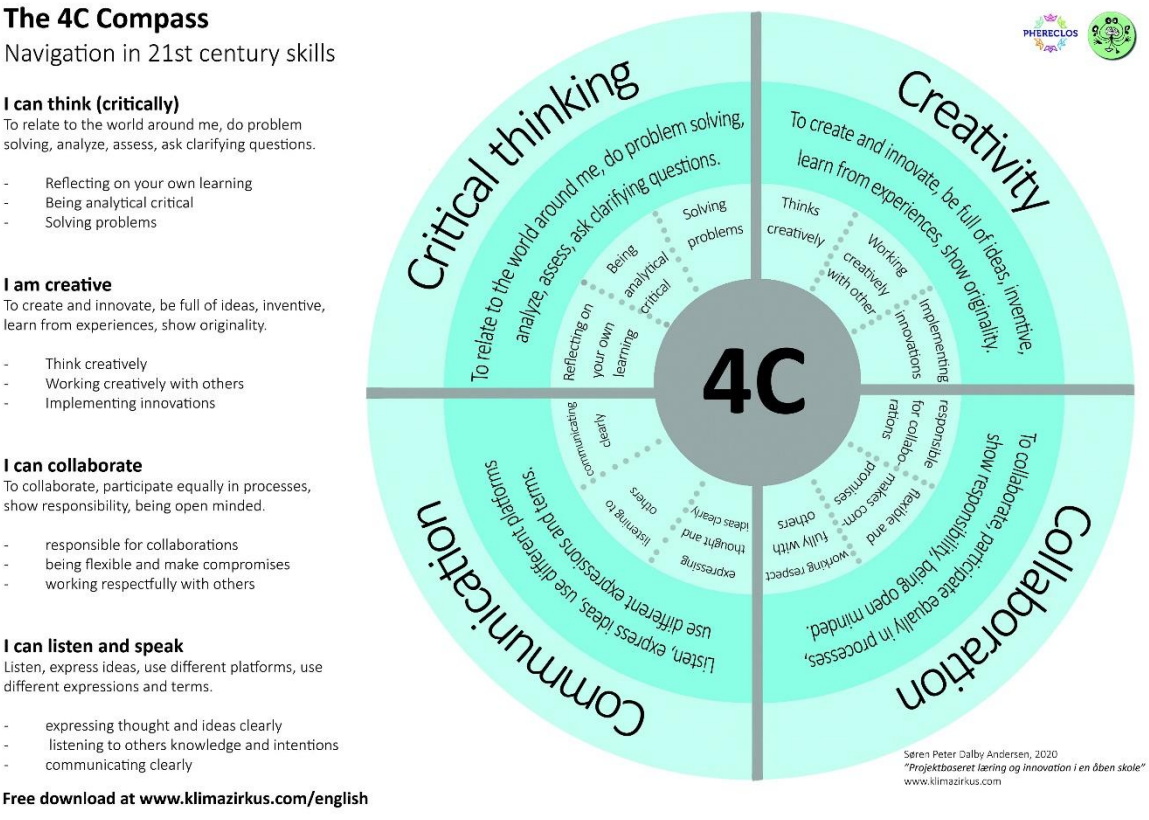


FIGURE 4. THE 4C COMPASS OF 21ST CENTURY SKILLS. (KLIMAZIRKUS 2020)

The 4C's are visualised in the poster where the competencies have been operationalised into formative assessment statements. The illustrations are models made by KlimaZirkus, TEMP 7, from Denmark.

The underlying skills for each competency are shown in figure 4. They are operationalising the competencies in learning situations in school and Open Schooling. The four competencies in the compass are related, and in practice, it can be difficult to work with them separately. The purpose is to unfold the competencies so that they are implemented when the pupils start to work in a project-based or another participative oriented learning activity.

The training activity for 4C terminology and skills can be accessed here

Innovation in Open Schooling

While the 4C's are determined as key skills for citizens in the society of now and the future, the innovation competencies are part of a different domain for the pupils to master. Innovation competencies overlap in terminology with 4C skills, but are more oriented towards meta-learning, or learning how to learn.

It is not necessarily easy to crack the code on how to incorporate innovation into educational practice. KlimaZirkus has developed a tool, where the aim is for the teachers, pupils, external partners and parents to have a common language for talking about the development of the traits and skills that lead to competencies in innovation.

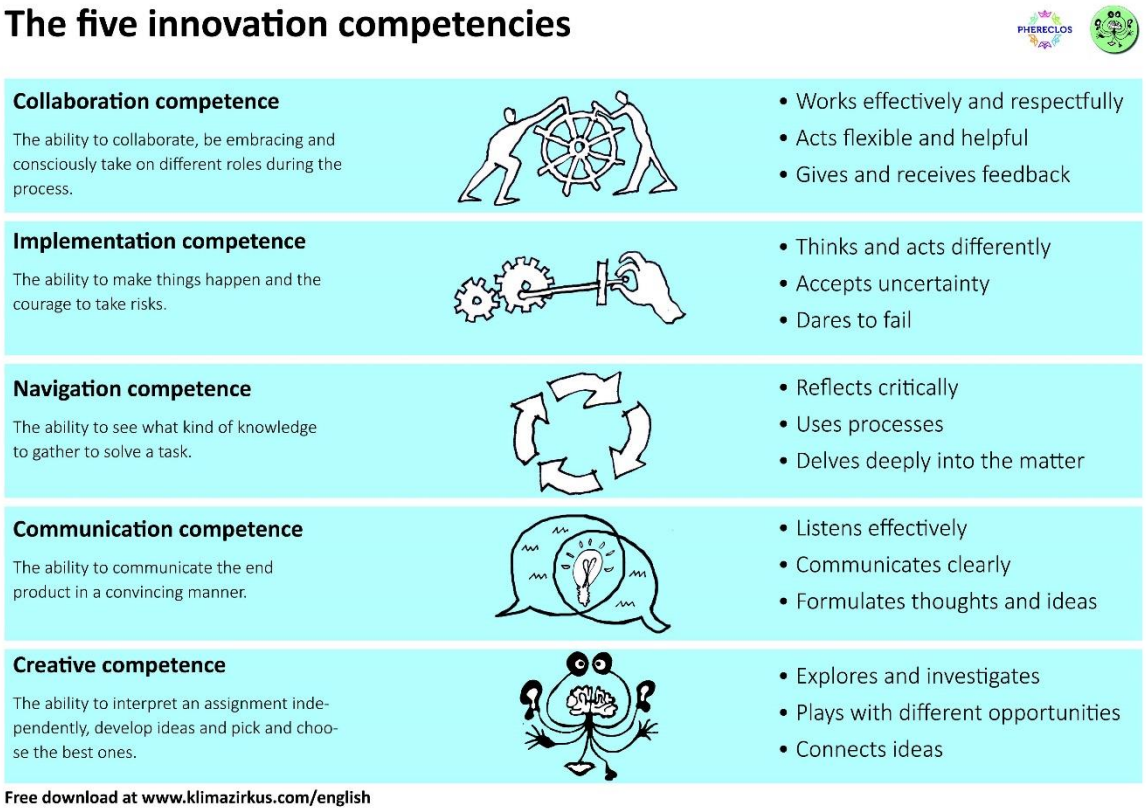


FIGURE 5. THE FIVE INNOVATION COMPETENCIES WITH CONNECTING COMPETENCIES (KLIMAZIRKUS 2020)

The 15 coupling competencies placed to the right in the table can be elaborated into even more detailed "signs of learning" that will give the pupils, as well as teachers an idea of how competencies are expressed. The signs of learning are also a way of assessing the process, which often will be difficult to evaluate in a product. The very concrete examples of 'learning signs' are also an opportunity for having conversations with the pupils about their own experience of the working process.

Process or product?

It is important to emphasise that the focus is on mastering a process, and less on the outcome of that process. Therefore, a group of pupils can work in a very innovative oriented way, without producing anything unique or groundbreaking. Pupils will still be assessed to be on a high level when they master the methods (Sølberg 2015).

The reason why innovation is part of the tool for innovation in Open Schooling is the focus on creating solutions and solving problems in authentic scenarios and settings.

Innovation for complex problems

In order to be able to learn how to take on challenges and solve problems without a given answer or predefined result, there is a need to be able to define, train and assess competencies that can support this type of learning activities.

These activities could be in a design challenge to a problem in a human-centred design process, or simply the ability to come up with a qualified experimental design for a science inquiry. Innovation competencies cannot be trained by following conventional fact driven transmissive science teaching, hence, this focus on innovation competencies in a broader perspective. These are important in all school subjects, and also in STE(A)M and in particular in Open Schooling. The five innovation competencies are inspired by fieldwork in educational research that analysed the most prevalent traits from working with innovation in school (Nielsen, 2015).

Use the signs of learning table to determine which competencies to focus on.

When working with soft skills and competencies it is valuable to be able to determine what is being focused on when. Planning the activities it can be very helpful to navigate in table 2 below, and define which signs of learning the groups of pupils should be assessed by. The table is an elaboration of the competencies described in figure 5. Pick out the ones that matter for a specific activity and focus on others later.

TABLE 2. EXTENDED TABLE OF INNOVATION 5 COMPETENCIES WITH SIGNS OF LEARNING

Basic innovation competency	Collaboration	Implementation	Navigation	Communication	Creativity
Coupling competence #1	***Works effectively and respectfully***	***Accepts uncertainty***	***Reflects critically***	***Listens effectively***	***Explores and investigates***
Sign of learning #1	Takes on a partial responsibility for a collaboration	Accepts that the solution isn't given in advance	Handles knowledge and information in a functional way	Communicates with different kinds of recipient groups	Asks curious and relevant questions
Sign of learning #2	Appreciates the individual contributions from others	Does not make too hasty decisions	Works in contexts with information density	Can listen to and accept others opinions	Tests knowledge through studies and investigations
Sign of learning #3		Understand that a solution is created through a process	Assesses, structures and prioritises knowledge and information	Analyses knowledge, values, opinions and intentions	Challenges common assumptions
Coupling competence #2	***Acts flexible and helpful***	***Dares to fail***	***Uses processes***	***Communicates clearly***	***Connects ideas***
Sign of learning #1	Willing to make compromises	Has a dynamic mind set	Uses method to create overview	Uses different media for communication	Connects concepts, thoughts and theory with one's own ideas.
Sign of learning #2	Aspire others to contribute	Regards fails as a part of a learning process	Makes decisions on the work process	Makes decisions about communication of a message	Uses the available institution (school or open school partner)
Sign of learning #3	Willing to develop on others ideas	Is persistent, even when it is difficult	Understands the difference between different phases in an iteration process	Plans and conducts an interview	
Coupling competence #3	***Gives and receives feedback***	***Thinks and acts differently***	***Immerses***	***Formulates thoughts and ideas clearly***	***Plays with different possibilities***
Sign of learning #1	Participates in discussions	Trusts in own ideas	Uses subject oriented language to understand and decode problems	Motivates and engages	Finds solutions to challenges
Sign of learning #2	Soft on people, hard on content	Has the courage to speak up and stand by one's own opinion	Identifies relevant subject content	Convinces others	Assesses and chooses ideas and feedback
Sign of learning #3	Uses feedback, feed-up and feedforward	Dare to take a chance	Decodes subject oriented problems	Communicates ideas/suggestions to solutions understandably	

Divergent and convergent thinking

The aim is to support the development of innovative pupils that master divergent and convergent actions and reflective of the phases that are part of an iterative process.

Divergent thinking is described as opening for possibilities and perception. That means that the pupil searches, scans, enhances, asks and investigates something.

Convergent thinking is characterised by action where the pupil focuses, compares, narrows down, analyses, synthesises and makes choices (Darsø, 2011).

Determine the nature of the activity - five categories to choose

When working in a project-based oriented way, the preliminary decisions on what kind of approach that fits the situation and the pupils' best are important. In this model, there are five main categories that can sort out what path that will fit the available resources and also the intentions and motivation among pupils, teachers and external partners. As stated before, a real project-based learning process can last weeks but it can also be planned to just last a day or two.

Any of the five categories is applicable to an Open Schooling context. Whether a museum visit addresses an issue or a local company is collaborating with the pupils over an authentic problem or challenge. The categorisation also helps pupils to navigate how to choose relevant methods.

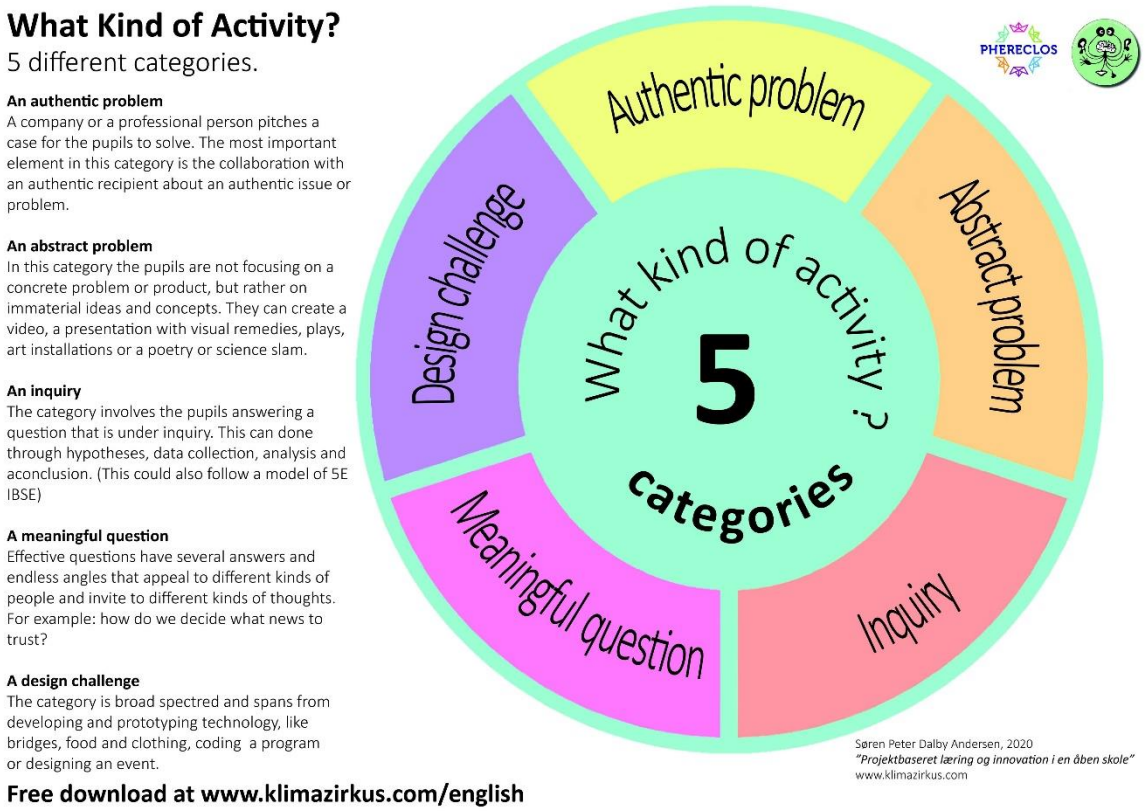


FIGURE 6. FIVE CATEGORIES OF ACTIVITIES TO CHOOSE (KLIMAZIRKUS 2020)

In the PHERECLOS project, there are very diverse examples of Open Schooling approaches. Many of them fall under more than one activity category, but do have a stronger position in one over the others. The inspiring examples below show how the Open Schooling activities have very different characters and yet still live up to the criteria of pupil oriented authenticity and participatory approach. Have in mind that these examples are described from an external partner's perspective.

1. **An authentic problem**
   A company or a professional person pitches a case for the pupils to solve. The most important element in this category is the collaboration with an authentic recipient about an authentic issue or problem.

   The Medellin LEC led by EAFIT Children's University, seeks to encourage students to engage with science as a useful tool to the solution of local problems through active learning experiences (called teaching units) addressing, as a pedagogical strategy, eight city-relevant issues (health, environment, economic development, culture, mobility, gender equity, youth and social inclusion). These were co-designed by academia, the private sector, non-profit organisations and the public sector.

2. **An abstract problem**
   In this category the pupils are not focusing on a concrete problem or product, but rather on immaterial ideas and concepts. They can create a video, a presentation with visual remedies, plays, art installations or a poetry or science slam.
   The problems could be formulated as: How can I remember my dreams, since I was asleep? Is there life on other planets? What does nature mean to me? Are robots good or bad?

   The transnational mentoring partnership between Serbian and Hungarian Schools and the NGO Liget Műhely Alapítvány - Dragonfly, have developed a catalogue of brief science oriented workshops based on the principle of experiential learning. The program targets socially disadvantaged areas in Hungary and Serbia The description and online catalogue "Dragonfly" can be accessed here.

3. **An investigation/inquiry**
   The category involves the pupils answering a question that is under investigation. This can be done through hypotheses, data collection, analysis and a conclusion. An inquiry-based learning approach can also be adjusted to fit the skills of the pupils.

   The transnational mentoring partnership between Portugal and Spain - has been working with entrepreneurship and innovation with young teenagers. Here they explored the synergy between inquiry-based science education, innovation and entrepreneurship. One of the partners, Xuvenciencia from University of Santiago the Compostela offers inquiry-based science activities with socio-scientific relevance.

4. **A meaningful question**
   Effective questions have several answers and endless angles that appeal to different kinds of people and invite different kinds of thoughts. For example: how do we decide what news to trust? What do plants mean to us in our daily lives?

   The transnational mentoring partnership between Serbian and Hungarian Schools and the NGO Liget Műhely Alapítvány - Dragonfly, have developed a catalogue of brief science oriented workshops based on the principle of experiential learning. The program targets socially disadvantaged areas in Hungary and Serbia The description and online catalogue "Dragonfly" can be accessed here.

A design challenge
The category is broad spectred and spans from developing and prototyping bridges, new foods or clothing, coding a program or even designing an event.

LEC Lodz, a partner in PHERECLOS, has been supporting pupils' development and design process in creating their children's conferences focusing on the future labour market in tech and science.

Example: An inquiry - in six steps by Metodelab

The circle in the MetodeLab model is a simplification of a scientific process. It goes from single surveys to scientific knowledge and insight. Ideally, the scientific process starts with an inquiry that is being reformulated into a hypothesis. The hypothesis or the presumption is pursued in an investigation design, which results in a form of data. This data must be processed and interpreted, so that one can answer the question and draw conclusions. The conclusion ends the process or can then lead to another inquiry and the iteration in the model starts over (Kofod & Tougaard, 2014).

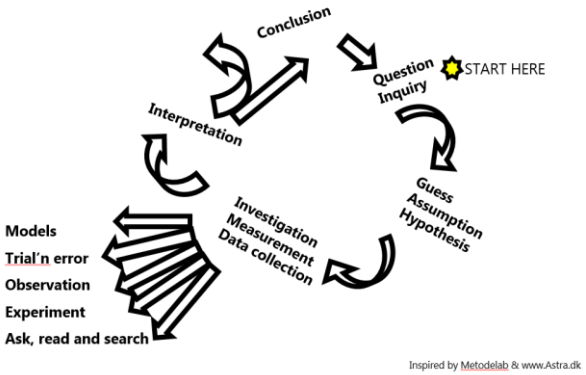


FIGURE 7. METODELAB MODEL OF INQUIRY BASED SCIENCE EDUCATION

The single steps in the circle can be adjusted in autonomy in order to both support and challenge the pupils with the amount of complexity that fits them best. Read more about this in the next section.

In a quick run through of the model, there will be short suggestions on how to work with the pupils in practice and in the perspectives of an Open Schooling collaboration.

Find the training activity for creating an inquiry-based science activity here

Adjust the autonomy in inquiry-based science education

How do you find the right balance between the competence level of the pupils and the degree of autonomy in the learning activity? The challenge here is that if you open the framework too much and the pupils are not capable of mastering the amount of information and methods, there is a risk that they get lost in the process. On the other hand, if they are familiar with the methods in play, there is a good reason for opening the level of autonomy in the work process. No matter what, the teacher's role as a guide and facilitator, listening, and asking the right questions is still essential.

The autonomy activity presents a model for adjusting the degrees of freedom in the individual steps of a learner-centred approach in order to adapt the activity to the pupil's level of skills, knowledge and competencies. The activity and tables are developed with inspiration from the work of Astra, the Danish national centre for science education.

Find the training activity for adjusting the level of autonomy in science inquiries here

Example: A design challenge

Authentic problems in school situations that are challenging pupils to develop suggestions for solutions is a qualified way of pushing the autonomy and ownership of the learning process towards the learner. A process that demands competences from creativity, innovation, critical thinking, collaboration and communication in order to succeed. Training the courage to try, fail and try again, when you develop solutions is also a competency that is important in this design-thinking domain.

Defining problems and designing solutions, challenges people to be creative, but also systematic and structured. This activity is based on a design thinking method called Double Diamond that was introduced by the British Design Council in 2005. It is used by a diverse spectrum of people, from professional designers, engineers to students and schoolchildren. A design challenge could easily be introduced after a more science oriented methodology, where an inquiry has led to a new understanding of a phenomenon, problem or causality.

[Find the training activity for creating a design challenge here]

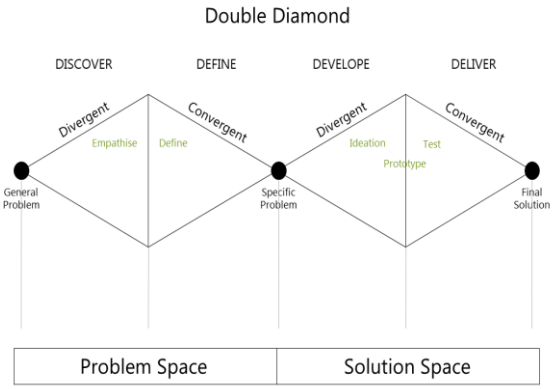


FIGURE 8. DOUBLE DIAMOND MODEL FOR DESIGN THINKING (BRITISH DESIGN COUNCIL 2005)

Validate the construction of the Open Schooling activity

In order to evaluate the structure, focus and methods in play, you can use the model in figure 9 from KlimaZirkus. It is divided up in eight basic elements. An activity does not have to contain all eight elements. However, it is important to be aware of which are there and how they are represented. These elements connect the relation between subject aims and goals, skills, knowledge, methods and meta-learning.

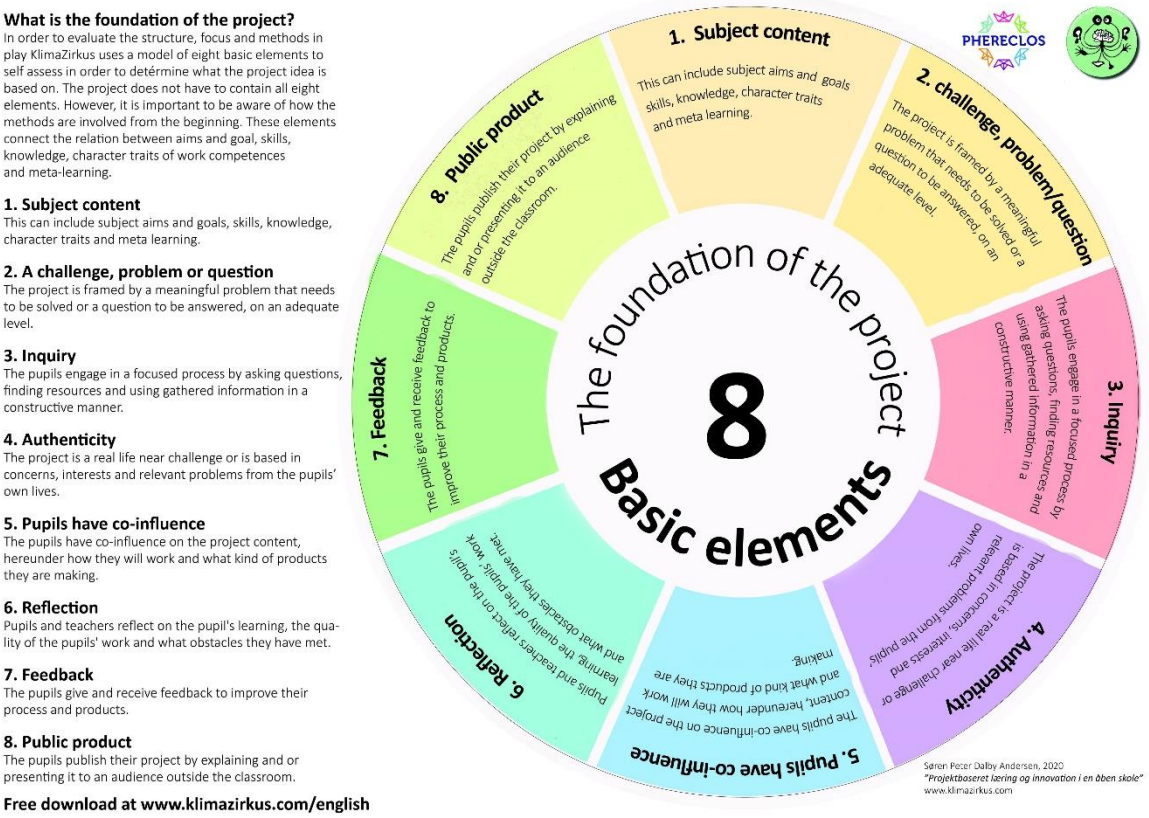


FIGURE 9. VALIDATE EIGHT BASIC ELEMENTS OF THE PROJECT OR ACTIVITY (KLIMAZIRKUS 2020).

A basic validation activity using the eight basic elements wheel is simply to go through each "spoke", where you assess and discuss whether this element is present or not, and to what extent. As mentioned, there is no predefined right or wrong. However, there will be some elements that are important for reaching a participative format. Number 4: "Authenticity" and number 5: "Pupils have co-influence", are worth considering whether they can be left out in order to live up to criteria of target group relevance and participative approach. The model is meant as a visual approach for an Open Schooling team of teachers and external partners to have a common ground to assess, develop and make decisions.

In table 3 below, there is an opportunity to structure the assessment of the eight basic elements in a simple template.

TABLE 3. WORKSHEET FOR ASSESSING THE OPEN SCHOOLING ACTIVITY THROUGH EIGHT BASIC ELEMENTS

Category	Description	Own notes (yes/no/comments)
1. Subject content	This can include subject aims and goals, skills, knowledge, character traits and meta-learning.	
2. A challenge, problem or question	The project is framed by a meaningful problem that needs to be solved or a question to be answered, on an adequate level.	
3. Inquiry	The pupils engage in a focused process by asking questions, finding resources and using gathered information in a constructive manner.	
4. Authenticity	The project is a real life near challenge or is based on concerns, interests and relevant problems from the pupils' own lives.	
5. Pupils have co-influence	The pupils have co-influence on the project content, hereunder how they will work and what kind of products they are making.	
6. Reflection	Pupils and teachers reflect on the pupil's learning, the quality of the pupils' work and what obstacles they have met.	
7. Feedback	The pupils give and receive feedback to improve their process and products.	
8. Public product	The pupils publish their project by explaining and or presenting it to an audience outside the classroom.	

Summary: Use the Participative Based Learning approach as assessment tool

Using the tools presented, you can quickly validate whether the Open Schooling activity you are planning contains essential elements in order to live up to criteria that have been set up, e.g. participation, learner influence, innovation, etc.

The tools presented in the PLAN section were:

- The SMART planning tool
- I Do ARRT - A method for setting up participative and meaningful meetings
- Didactic transposition - How to develop educational material from scientific articles or a professional domain
- 4C Compass - the relevance of and incorporation of 21st century skills in Open Schooling
- Innovation competence as practice oriented elements in STEAM
- Different types of activities in Open Schooling, with emphasis on
    - How to create activities with design challenges
    - How to Create inquiry-based science activities
    - How to adjust the level of pupil autonomy in inquiry-based learning
- An Open Schooling assessment tool to validate the core elements of the activity

This can be used as the final validation of the Open Schooling collaboration plan before the pupils are added to the equation and the activities.

Practice Open Schooling

Three step rocket of Open Schooling

The general experience from doing Open Schooling visits shows that well prepared pupils have a stronger learning experience when they are exposed to the out-of -school resources and settings in comparison to unprepared peers. The same goes for the follow-up. The reflection work on what has happened and how it connects to the preparation for the Open Schooling activity has a great significance on the general learning experience for the whole class.

Prepare the pupils - step 1

When working with established Open Schooling partners, the probability for acquiring well-produced preparation material is usually greater, than with new informal learning environments. In the absence of preparation material, the schoolteacher and the partner will most likely have the responsibility for developing and producing the inflight session that prepares for the Open Schooling activity. The content and format for this can be anything from a relevant explainer movie to an article or a discussion on what their own expectations are for the upcoming activity.

Visit, engage and learn - step 2

A shorter visit to an out of school site or a visit from an external partner can function as an inspirational kick-start or a wrap up in a science theme in the curriculum. Rome was not built in a day, and neither was STEAM in Open Schooling. Maybe start up in smaller steps and build upon the successes you gather.

The Open Schooling activity can have many forms, and it is important to have a clear plan of the day and let the children in on it. There is nothing more frustrating no matter how old you are, than not knowing what is going to happen.

It is worth considering information such as:

- Is the visit involving actual practical activities or is it a guided tour?
- Will there be elements of inquiry, investigation, modelling, and problem solving or debating?
- How are they introduced to the program when the day starts? Are they actively involved and asked about their expectations of the visit?
- If they have been preparing for the Open Schooling activity, they will often have some idea of their expectations.

If the school class has been preparing prior to the visit it is of uttermost importance to make sure that prep-work will be put into use and action, so that they actually experience the relevance. This could be by having a small plenary or group session where the topic is “My expectations for today”, or “what do already know about…”

Whether the class goes to visit an external partner or receive a visit from an external partner in school does not matter. Both are relevant models for an Open Schooling activity. Either way the school day will be different from what the pupils are used to. The aim of the Open Schooling session can be different and it is important for the teacher and the external partner to be on the same page regarding the content, format, rules and roles across the day.

Often this day will be an opportunity for the teacher to step a little bit into the background, and have the privilege of being more of an observer and secondary facilitator while the primary responsibility is on the external partner. This observer role gives opportunity for the teacher to see how the pupils are interacting and may focus on what kind of skills and competencies they are using, for example with respect to the 4C’s of the 21st century skills, innovation competencies and subject oriented terms.

Logistic challenges - duration and transportation

There are no rules for how long a visit or a collaboration should be, or if there should be more of them, or even mutual visits. The change of scenery and educator can bring a different authenticity into the learning

experience and the variation can increase the attention form and maybe the motivation in pupils that are not necessarily active in science class. For some schools it will be easy to find collaboration partners and fix transport, while it can be difficult for others. That is why a collective mapping of the local assets and opportunities (Activity 1) can help Open Schooling practice on the way.

Reflect and evaluate with the pupils - step 3

After an open school activity, it is important to reflect on the experiences and learning from the pupils. In this phase, it can be relevant also to include the preparation activities as a comparison for the pupils' reflections on the outcomes of the meeting with an external informal learning environment. In this approach, the preparation activities will be used in the after-phase for reflecting on the Open Schooling experience.

In this case, there will be different domains to evaluate:

1. The curriculum oriented skills and knowledge that lies within the subjects are important in order to live up to the school legislation criteria for learning aims and goals.
2. It could at the same time be considered to use a parallel assessment approach that includes the formative signs of learning from the 4C skills model and maybe elements from the five innovation competencies.

This is where the model of the eight basic project elements can be a very concrete assessment tool for making it visible where the project/activity focus is, also in terms of learning evaluation.

3. The teachers and external partners should also do their own evaluation session while the experience is still fresh in mind.

Case from PHERECLOS: Greek mythology meets German biodiversity issues

In the PHERECLOS Transnational Educational Mentoring Partnership (TEMP) between formal and informal learning institutions from Germany and Greece, the development of an open school concept was formed. The aim was to create a form where Greek mythology, art and culture meets authentic ecological and environmental sustainability issues. There is more information on the collaboration here.

In the following, the original plan has been adjusted and downsized in detail and fitted into the "Three step rocket model".

The Legend of Hercules and Augeas' Stable in Sustainability dilemmas

One of Hercules' tasks was to muck out the stable of a king called Augeas. Augeas possessed more than 1.000 cattle, and his stable had not been mucked out for several years. Additionally, Hercules was only given one day's time. Hercules solved the problem by knocking down one wall and digging a channel, thus directing the water of two rivers right through the stable. That way, the stable was mucked out in one day.

Several of the UN sustainability goals (SDG) can be associated with this legend. The workshop below will connect with the SDGs 6 (clean water), 11 (sustainable communities) and 14 (life under water).

The narrative of the myth is used in combination with the physical workshop: "Watercourse as a Biotope" for children of 8 – 13 years.

Initial situation

In the central Thuringian town of Großenehrich in Germany, a creek is flowing right through the town. Naturally, dilemmas between SGD's will arise from this fact. The children participating in this workshop will reveal them and deal with them.

The following original content and description of the workshop has been moved around, so it fits well into a 3-step model for Open Schooling activities.

1. Step: Preparation (at home)

The pupils will be told the legend of Hercules mucking out Augeas' stable. At its end, the children will be asked whether they think Hercules did a good job and discuss why in smaller groups.

They will also work with a general introduction to the global water cycle.

Pupils will also be introduced to the upcoming visit at the creek location, where they become familiar with some of the activities on the visit.

2. Step: The visit (at the local site, with external facilitators)

Welcome to the external learning environment

For a start, all children will do a pantomime titled „everything's flowing", about the worldwide water circulation (with some of the possible interruptions or detours).

Fieldwork

The children will then go out in the field and describe the area and how the different nature types are represented. This will go into the assessment of the creek's structure.

The group will also sample plants, and use the specimens to decide the ecological type in terms of nutrient load etc.

The third step is to make water samples of the water fauna and define the species in order to determine the quality of the water. This is done by analysing the living criteria for the collected fauna specimens.

From the species of the sampled animals and their specific biotope requirements, the teams will be able to judge the quality of the water.

Analysis and conclusion

The final assessment will show that, whereas the structures of the creek are near natural, plants and animals indicate eutrophic water quality. This is caused by nutrients-loads of sewage coming from gardens or small-scale livestock keepings flowing into the creek as it cuts right through the town.

The circular conclusion to the legend of Hercules and Augeas

Just as livestock keeping and gardening close to the creek can cause pollution, Hercules did so by using rivers to muck out stables, since the muck will stay in the water. So, the children will be asked if they still believe that Hercules did a good job, or what problems would arise from his solution (water pollution, destruction of two rivers with all the ecological consequences).

Goals

The children learn to understand a creek as an ecosystem, consisting of the creek as such, its shore areas and the biocenosis. They find out that the state of this biocenosis can be derived from certain plants and/or animals living or not living there. In that way, they learn to think in relationships. They get a first idea of biodiversity. They may realise that human activities have an impact on the state of the creek as an ecosystem and that therefore humans have a responsibility.

3. Step: After the visit and reflections (back in school)

Dilemmas to be investigated and addressed:

Having gardens and low-intensity livestock keeping in a community, especially a town, most certainly adds up to the fulfilment of SDG 11 (*sustainable cities and communities*).

As this workshop shows, it can collide with SDG 6 (*clean water and sanitation*) and, in consequence, SDG 14 (*life below water*). Moreover, there is even an intrinsic dilemma, because SDGs 6 (*Clean water and sanitation*) and 14 (*Life below water*) would also be important to reach SDG 11.

The idea of the workshop is for the children to understand these topics in the SDGs and how they connect with their everyday lives. Additionally, they train themselves to find the possible conflicts for example, how do we avoid water pollution, improve water quality and still can have gardening and low intensity livestock keeping having a community worth living in. They also train how to address them and discuss them between themselves, finding possible solutions.

Most probably, there will be more than just one solution to the question. The important thing for them will be to learn to listen to and consider every opinion and get to understand other people's possibly different opinions, before coming to a final solution. Maybe they will even end up with more than one final solution.

Evaluate your Open Schooling activity

What can be in the focus of your evaluation?

The evaluation of an Open Schooling project is dependent on the defined success criteria and the method: Evaluating on marks and grades tend to put the eyes more on the result rather than the process. For Open Schooling projects, we recommend focusing especially on the evaluation of the process – e.g., the development of pupils' creativity, their ability to self-assess teamwork, their development of communication.

You could use the 4C compass and the five innovation competences for defining some of the soft skill outcomes in combination with more subject- and disciplinary oriented skills and knowledge.

However, it might also be interesting not only to consider changes in pupils' competences but also to look at the process of the collaboration with the other partners in the Open Schooling project. Gathering such information during the implementation might help you manage your Open Schooling project better.

To determine the focus of the evaluation, it might also be useful to revisit your implementation plan and look at the goals and target groups noted there.

How to conduct an evaluation?

To develop a plan for your evaluation, it is helpful to visualise the **steps of an evaluation** and the questions that are important to clarify here (see Figure 1).

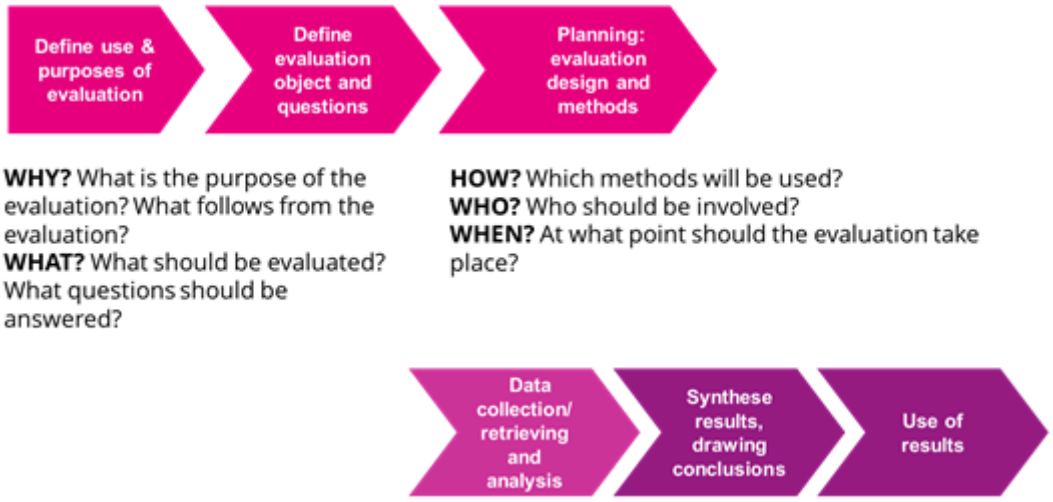


FIGURE 10. EVALUATION STEPS.

We recommend that the Open Schooling team think carefully about the **purpose**(s) of the evaluation already in the planning phase of the Open Schooling project. Furthermore, they should determine,

… which **specific questions** should be answered with the evaluation (e.g., is it more about the evaluation of the outcomes on pupils' level – for example how their communication skills develop over time - or more about how the partners worked together; what exactly is of your interest and helpful for you?),

… which **methods** should be used to answer the questions (questionnaires, tests, interviews, focus groups, observations, document analyses, etc.), and

… what are suitable **measuring points?** An evaluation could provide helpful information even before the actual implementation of the Open Schooling activities, e.g., how activities really fit to the needs of the pupils. An accompanying (formative) evaluation of the process and/or a final evaluation certainly also

provide valuable insights into the status of goal achievement. During the implementation phase, data should not only be gathered and analysed, but also discussed within your team, and communicated to relevant others.

Furthermore, a participatory (Guijt, 2014; Zukoski and Luluquisen, 2002) and utility-based approach (Patton and Campbell-Patton, 2021) has proven successful for the development of such an evaluation plan. This means that the inclusion of stakeholders, e.g. parents, important players in the community, is very beneficial to receive evaluation results that are regarded as useful. Furthermore, the stakeholders get more committed to your project – and will probably also support you best in conducting your evaluation. Therefore, a participatory and utility-based approach is recommended.

As you might have recognized: There are various types of evaluations, which differ on the one hand in *who* carries out the evaluation and on the other hand, in *when* they are conducted (Scriven, 1991):

Self-evaluation is the process of systematically observing, analysing, and improving one's own actions or results.

Peer Review is an assessment by external experts or colleagues.

External evaluation is conducted by persons who are outside the system or internal third parties, e.g., persons from quality management.

Summative evaluation is the final assessment of the degree of goal attainment, e.g. improvement in team competencies or skills, after the implementation of your project.
(Mnemonic: You summarise the results of your project.)

Formative evaluation reduces risks during the development of your project or during the implementation. This kind of evaluation should bring you information about which modifications should be made and maximises the likelihood that your project will succeed.
(Mnemonic: You form the results of your project). Said with the words of Robert Stakes, a famous evaluator: "*When the cook tastes the soup, that's formative. When the guest tastes the soup, that is summative evaluation*".

Why is it useful to get feedback on your Open Schooling project and document it?

In some cases, there may be no resources at all or too few competencies to carry out an evaluation of the Open Schooling project. In these cases, it is recommended to ask for *feedback* at least from the main target groups (pupils, parents, colleagues and project partners) from time to time and to check for yourself if you are on a good way to reach your SMART formulated goals. Keeping the goals of the Open Schooling project in mind helps to keep the focus and to adapt the activities in such a way that they lead more towards the achievement of the goals. Sometimes, however, it will be necessary to sharpen the SMART goals and/or to formulate new, different goals that are even more tailored to the needs of your target group(s).

A good *documentation* of the Open Schooling project may seem tiresome at first sight, but it can be very helpful to document for example agreements made, the implementation process itself and experiences that were made. This is because future other Open Schooling projects with similar content and contexts will have a good model to follow. Good documentation thus supports sustainable capacity building at schools for conducting Open Schooling projects.

Also, communicate and share your experiences and successes within the school, with parents, with partner organisations, etc. This way, they also could contribute their view, learn something, and feel involved. In addition, do not forget to celebrate the completion of the Open Schooling project together. You all have achieved a lot!

Find the activity for creating your own evaluation template here

Mainstream the activity to your local Open Schooling program

How to make the Open Schooling activity part of a continuous program in the local school community will often be the ultimate achievement from creating a new collaboration with an external Open Schooling partner.

If you are fortunate, you will have a resource person, or a local hub that can support the process from project to program. This is the role the Children's Universities have had in the PHERECLOS Local Education Clusters (LEC). If you are not so fortunate to have an Open Schooling hub nearby, there are some things to consider when elevating your collaboration into ongoing Open Schooling activities.

At PHERECLOS' website you can also find a *Sustained Modelling and Scenario Building Reference Guide* on how the local educational ecosystem can collaborate to create sustainable partnerships between schools and the local community. The findings from the Local Educational Clusters in PHERECLOS states, among other things, that the teachers are key persons in developing innovation in Open Schooling!

Going back to the evaluation plan, there is a lot of content here to pick up, in order to assess whether the collaboration has potential to be a steady part of the local Open Schooling program catalogue, and not just a "one hit wonder".

The evaluation of the collaboration, motivation of the partners, the pupils' learning experiences and stable economy/funding are all elements to consider in the process of mainstreaming.

Is it possible to seek stable funding from public sources? Moreover, is it possible to find a way to run this without the financial perspectives taking off?

This part of the process is probably the most difficult one. To transform from a project activity to an ongoing Open Schooling offer is important for the development of the educational opportunities you can draw upon as a teacher and offer your pupils. This cannot be done without the support of school heads, parents, the local community as well as local and national politicians. The co-work with some of these stakeholders are covered in other recommendations and resources available at PHERECLOS' website.

As a teacher, you are the one closest to the children during the school day, but the task of educating them for their future is also a family and community responsibility.

Summary

The aim of the Toolkit has been to be practice oriented and focusing on the teachers' role in the creation and making of Open Schooling. The local environment for Open Schooling is most certainly looking very different from rural areas to bigger cities, from one region to another and from school system to school system. Hence, this Toolkit can function as an inspirational platform to start up and, in time, find your own adapted ways of developing motivation, structure and content for your concrete Open Schooling approach.

Activities

Map opportunities for Open Schooling

Training activity 1 (80 minutes)

Introduction

How can you as a teacher make decisions on what Open Schooling activity to engage in? In addition, what are my options? Often there are possibilities hidden that were never considered. It can also be important to be aware of similar alternatives in order to maintain sustainable collaborations both ways. This training activity presents different methods to map the local resources for Open Schooling.

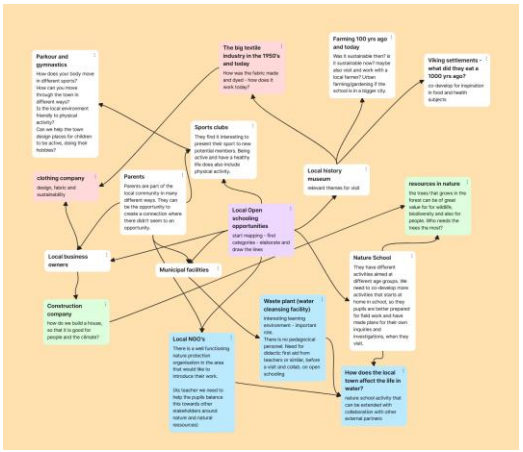


FIGURE 11. EXAMPLE OF MAPPING AN EDUCATIONAL ECOSYSTEM.

Purpose

The purpose of the activity is to use the school's own local community as a case for mapping the resources and opportunities for Open Schooling for your school and classes. The process is supposed to be exemplary for working out the local ecosystem potential of external learning environments and collaboration partners. The purpose is furthermore to work with creative and innovative methods in a teacher team/group to anchor the gathered knowledge and information in a sustainable and ethically appropriate way.

Aims and goals

The aim is to generate ideas and later produce the outline of an overview for exploring local Open Schooling collaborations. There should be made assessments of potential external partners' competences, in order to reflect on the teacher's role in that specific collaboration. The ethical aspects of gathering information of local resources could also be part of the planning process. Especially if the resources involve parents or family of the pupils in the relevant classes.

Success factors

- The work is conducted as a group task.
- The product, whether it is online or not, should have a character that will be easy to share and adjust to make sure it mirrors the actual possibilities at all times.
- There will be a choice of product type that matches the local needs for sharing and collaboration at school/community level (online, offline, digital, analogue).
- The product will be considered as a work in eternal progress, but yet qualified as a resourceful tool.

Description

The activity will start with a creative phase where ideas should sprout, followed by a condensing process that ends up with a prototype map will follow this phase.

Activity 1. Empathise - Who needs Open Schooling activities and why?
Activity 2. Brainstorm
Activity 4. Merging of ideas
Activity 5. Create a prototype
Activity 6. Present and discuss the outcomes in plenary

1. Empathise (25 minutes)

Map the local learning ecosystem! The purpose of this task is to create a visual map of the actors and their respective roles and interactions in the local ecosystem of learning.
The participants should work in small groups.

'Ecosystem maps' are constructed using two simple elements and a very simple process. First, the object of analysis *(Where can Open Schooling happen?)* and the delimitation of the system to be described are decided. Then brainstorm about possible actors in the system:

- Each actor is written on a piece of paper/sticky note.
    - If you are stuck in finding actors, look at a local google map or in the local newspaper or telephone book for companies, museums etc.
- Once the actors have been identified, the connections between them are examined.
- Where are the existing contacts, if any?
- Who does what for whom?
- Who is dependent on whom?
- What information flows are there in the ecosystem?
- The connections are written on arrows placed between the different actors.

The process is iterative, as the analysis of connections between actors often will come up with new actors during the session.
Finally, the system is simplified as much as possible and with a focus on the object of analysis, after which the result may be drawn on a poster.
The map can be drawn with representative icons for other schools, town hall, local business, waste plant, grocery store, museum, nature centre etc. The visualised ecosystem can be presented and discussed in plenary.

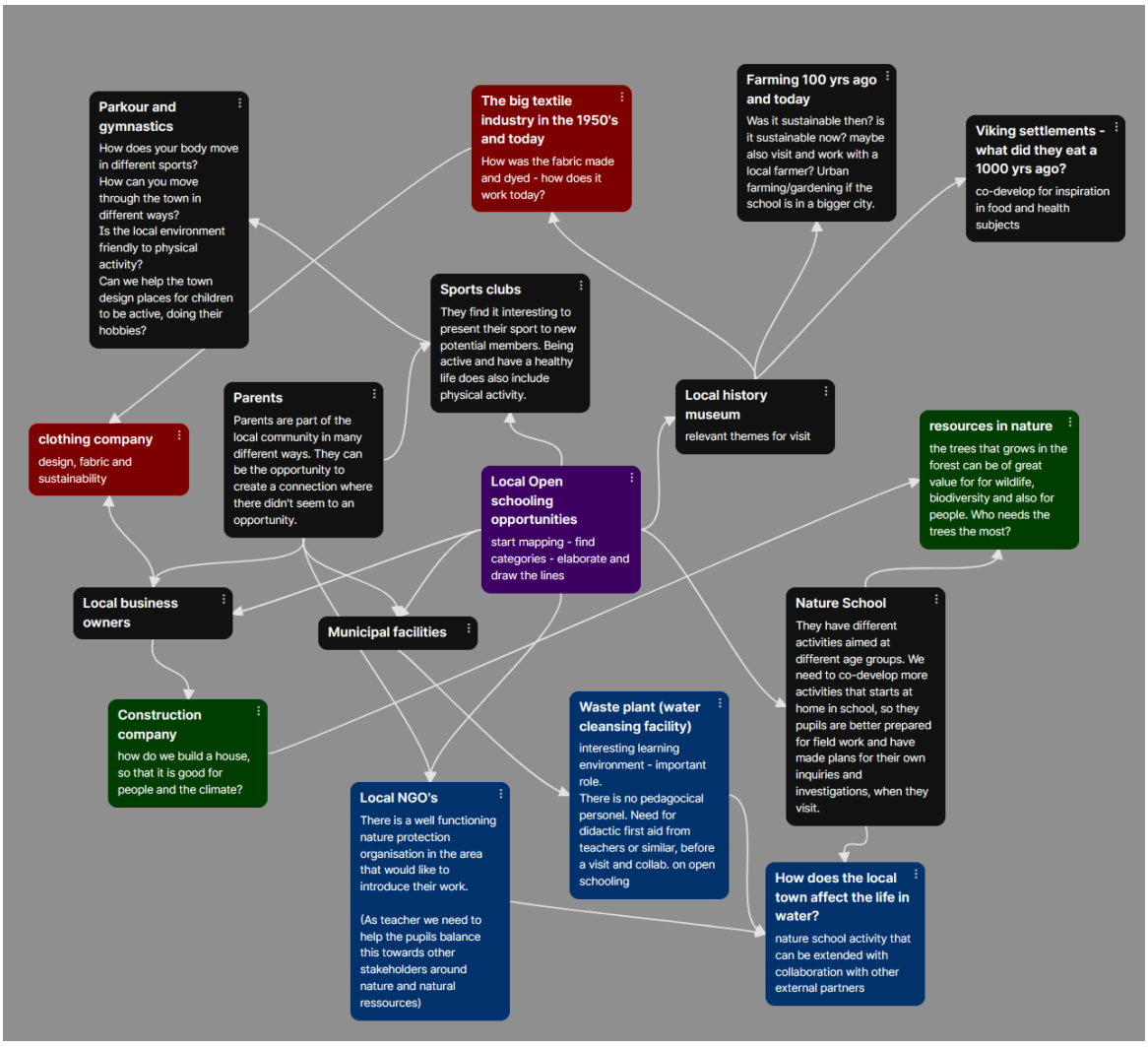


FIGURE 12. ECOSYSTEM MAPPING, THE MAP IS MADE IN THE WEB-APP WWW.PADLET.COM

2. Brainstorm (45 minutes)

Based on the mapping process, the participants should go into a brainstorm session focusing on different problems/goals and then select one/some to focus on & decide about qualified partners.

As a facilitator, avoid coming up with ideas or judging the ideas, since it is the participants who must generate ideas. The very quality of the ideas should be tested on users and other actors outside the teacher-training forum.

1. Ask participants to reformulate the problem or goal as a solution-oriented sentence starting with "How can we…", e.g. "How can we find a diverse spectrum of external partners for our school?" (5 minutes)
2. The participants now choose the best "How can we…" phrase. (2 minutes)
3. The rules for brainstorming are then presented (5 minutes):
    a. Do not judge your own or others' ideas
    b. Go for quantity
    c. One conversation at a time
    d. Encourage wild ideas
    e. Build on the ideas of others
    f. Maintain focus on the topic
    g. Be visual (and document)
4. Participants now write their ideas down on post-its, and place them on flipcharts. Feel free to give them a time limit (for example 5 minutes) so they do not have time to censor themselves too much
5. Reverse brainstorm: To twist the process a bit, now give the participants the task to come up with the worst ideas for collaboration partners in the next 5-10 minutes. Simply because, it can boost the idea generation to another level when it seems to be stuck. This twist can also contribute to the amusement and general group atmosphere, since some "worst ideas" really are silly.
6. The participants now take some of the worst ideas up, and try to remodel them into usable ideas. This process can be given time as long as there is a sense of momentum in the individual groups.

4. Merge ideas

The time is now for analysing the ideas that have been generated and merging the different suggestions and ideas that somehow have similarities. Do this by grouping sticky notes with common content. Use 5-10 minutes to rewrite the merged ideas into a common sentence.

5. Prototype a map of potential partners (10 minutes)

Create a visual product to present the ideas that came out of the merger. The product could be a mind map that presents the different possibilities, a virtual google map with pins for each potential resource, with a description, a hand drawn map over the local community or something completely different.

6. Present and get feedback

If it is possible, the product should be presented for stakeholders outside the workshop. This could be fellow teacher colleagues, key school administration staff, parents and/or pupils.
Let the audience give feedback on the presentation.
How did you find and agree on the criteria to select the final Open Schooling partner? Did a wild idea ever become qualified?
How did the reverse brainstorm work out?
Do you sense that there actually is an overview on the local options for working with external informal partners in school related activities?

Materials

- Sticky notes
- Flip Boards
- Markers
- Laptop computers (if online and digital products are in play)
- Optional: Online mind map tools - www.padlet.com or similar.

Signs of learning/formative assessment goals

- A broadened perspective of who an Open Schooling partner could be.
- A common understanding who, where and what can be approached
- A better mutual understanding of the term Open Schooling partners
- A greater motivation to integrate elements of Open Schooling into the lesson plans/curriculum

References

CLASSIC BRAINSTORM – Innovation and entrepreneurship in education (ku.dk)
ECOSYSTEM – Innovation and entrepreneurship in education (ku.dk)

Make "grown up" science accessible for Open Schooling

Training activity 2 (180 minutes

Introduction

Authentic and contemporary STE(A)M cases that you could find relevant for your classes are not always found in textbooks or even sufficiently developed into teaching material that fits the needs of your group of learners/pupils. In an Open Schooling situation, you could easily have qualified external partners but are still lacking the one and only authentic problem or case that fits the pre-understanding and interests of your pupils.

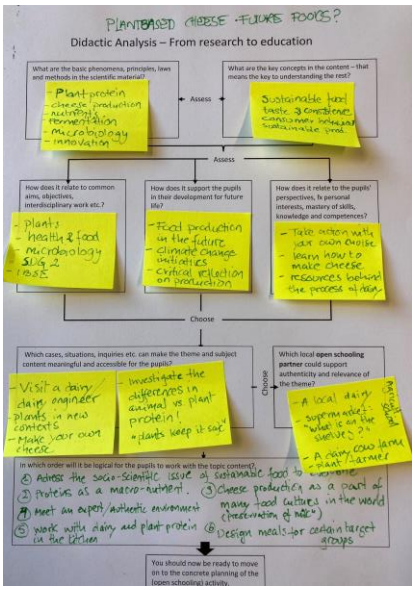


FIGURE 13. EXAMPLE OF DIDACTIC ANALYSIS - PLANT BASED CHEESE

So, how do you develop relevant educational material? Hopefully in collaboration with colleagues and external partners with special knowledge in the area of interest, by working in partnership.
In addition, how is this transformation done without losing the authenticity of the original narrative and the relevance of the Open Schooling setting? There is quite a difference in complexity from scholarly knowledge and research at university or within industrial research & development, to taught knowledge in middle school and lower secondary. That is why a deconstruction of original knowledge and a reconstruction aimed at the target group is necessary to overcome this barrier. This activity will introduce a method to make the didactic transposition from academic science content to school and Open Schooling based activities.

Purpose

The purpose of this activity is to create a prototype of educational content based upon academic STE(A)M research or professional knowledge from an industry or a business. Knowledge that needs to be deconstructed and reconstructed into material, which is accessible at school level in order to be relevant for the target group of learners.
Additionally, the described topic can support a collaboration between school classes and an external partner that provides an informal learning environment.
Ideally, there will be representatives from the external informal learning environments involved in this process, so that the making of educational material involves co-creation from the beginning.

Aims and goals

Participants will use the didactic model step-by-step to analyse, deconstruct and reconstruct a self-chosen topic from the field of STE(A)M research into a teachable/learnable case aimed at pupils from 10-16 years of age. The prototype theme should be developed in a way so that it later can be applied to different participative learning methodologies, for example problem-based learning, inquiry-based learning, experiential learning etc. Hence, the final didactisation into a concrete lesson plan and applied learning methodology lies beyond this activity.

- The participant will choose and work with a relevant STE(A)M related case for their target group and subjects.
- Depending on the age of the target group, it will add a deeper level of learning potential if the topic has a socio-scientific relevance to the target group.
- The case also has a relevant connection to an Open Schooling opportunity in the local community.
- The participant discusses and makes choices to transform the scholarly content into a participative form that can be accessed and is relevant for the target group of pupils.

Description of activity

Preliminary:

Find a relevant case that is authentic to the area of educational interest. The UN 17 Sustainable Development Goals can be a great starting point for selecting a relevant theme that also has a socio-scientific relevance. In other words, a top candidate would be a research or technical topic that includes societal relevance, which, to some extent, influences the everyday life of the pupils. The picture on the right gives examples on how science news can be the source of inspiration for an Open Schooling collaboration. However, it needs a bit of work before it is ready for the young pupils.

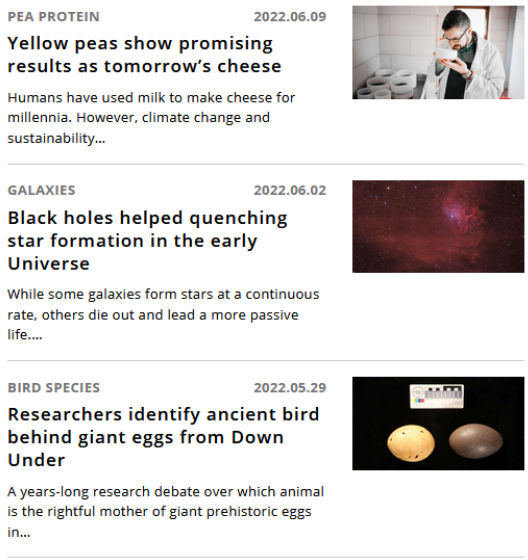


FIGURE 14. EXAMPLE OF SCIENCE RESEARCH THAT CAN BE TRANSFORMED TO TEACHING MATERIAL.

First step - Assess the science/professional elements: (45 minutes)

- Analyse and describe the basic phenomena, principles, laws and methods in the scientific material.
- What are the key concepts in the content – that means the key to understanding the rest of the story?

Second step - Assess the educational relevance: (45 minutes)

- How does it relate to common aims, objectives, interdisciplinary work etc.?
- How does it support the pupils in their development for future life skills?
- How does it relate to the pupils' perspectives, personal interests and their level of mastery in subject skills, knowledge and competences?

Third step - Choose the relevant angle, narrative and Open Schooling partner: (45 minutes)

- Which cases, situations, inquiries etc. can make the topic and subject content meaningful and accessible for the pupils?
- Which local Open Schooling partner could support the authenticity and relevance of the theme?

Fourth step - Assess the structure of the activity: (20 minutes)

In which order will it be logical for the pupils to work with the topic content?

Fifth step - Continue to the detailed lesson/project planning:

The didactic transformation is done, and the next step is to start planning the concrete learning activity, with the external partner. Also, apply the participative methodology of your choice.

Sixth step - Presentation and feedback session: (25 minutes)

The working groups team up two and two. They make a short presentation for each other, for example by using the template as the guide through the decision-making and choices. The feedback groups can now ask questions for clarification and background for didactic decisions.

Inspired by Duit et. al (2012) and the MER-The Model of Educational Reconstruction as a model for teacher professional development and a workshop from www.Astra.dk - on the topic "From research to school education in STEM" (Nana Quistgaard and Christina Frausing Binau)

Materials

- The template for didactic analysis - can be found in the attachment below. The template includes work on STEP 1-4 and STEP 5 & 6 are discussed based on the template work.
  (print in size A3 if possible)
- Different examples on contemporary science news articles or industrial cases
  - Science research news (https://science.ku.dk/english/press/news/)
  - Business - Hearing aid technology (https://www.gn.com/)
  - Business - water cleansing (https://eu.lifestraw.com/)
  - Science & technology stories from BBC
    https://www.bbc.co.uk/news/science_and_environment
  - Science in School - extensive teacher friendly content on science breakthroughs and available in multiple languages - https://www.scienceinschool.org/

Signs of learning

- The participants search and discuss different cases and agree on a common topic
- The didactic analysis template is used actively and the group discusses the priorities and potentials for learning in the case they are working
- The participants use and discuss scientific terms and the level of complexity they can include in order to fit the general knowledge and pre-understanding of the target group.

References

Achiam, Marianne. (2014). Didactic Transposition: From theoretical notion to research programme. (PDF) Didactic Transposition: From theoretical notion to research programme (researchgate.net)

Duit et al. (2012) The model of educational reconstruction - a framework for improving teaching and learning in science i Science Education Research and Practice in Europe Retrospective and Prospective, Jorde & Dillon (red.) https://link.springer.com/content/pdf/10.1007%2F978-94-6091-900-8_2.pdf

Website: https://bigbangnaturfag.dk/docs/years/2018/slidesws1/FraForskningtilUndervisning020818_AU.pdf

FIGURE 15. DIDACTIC ANALYSIS TEMPLATE.

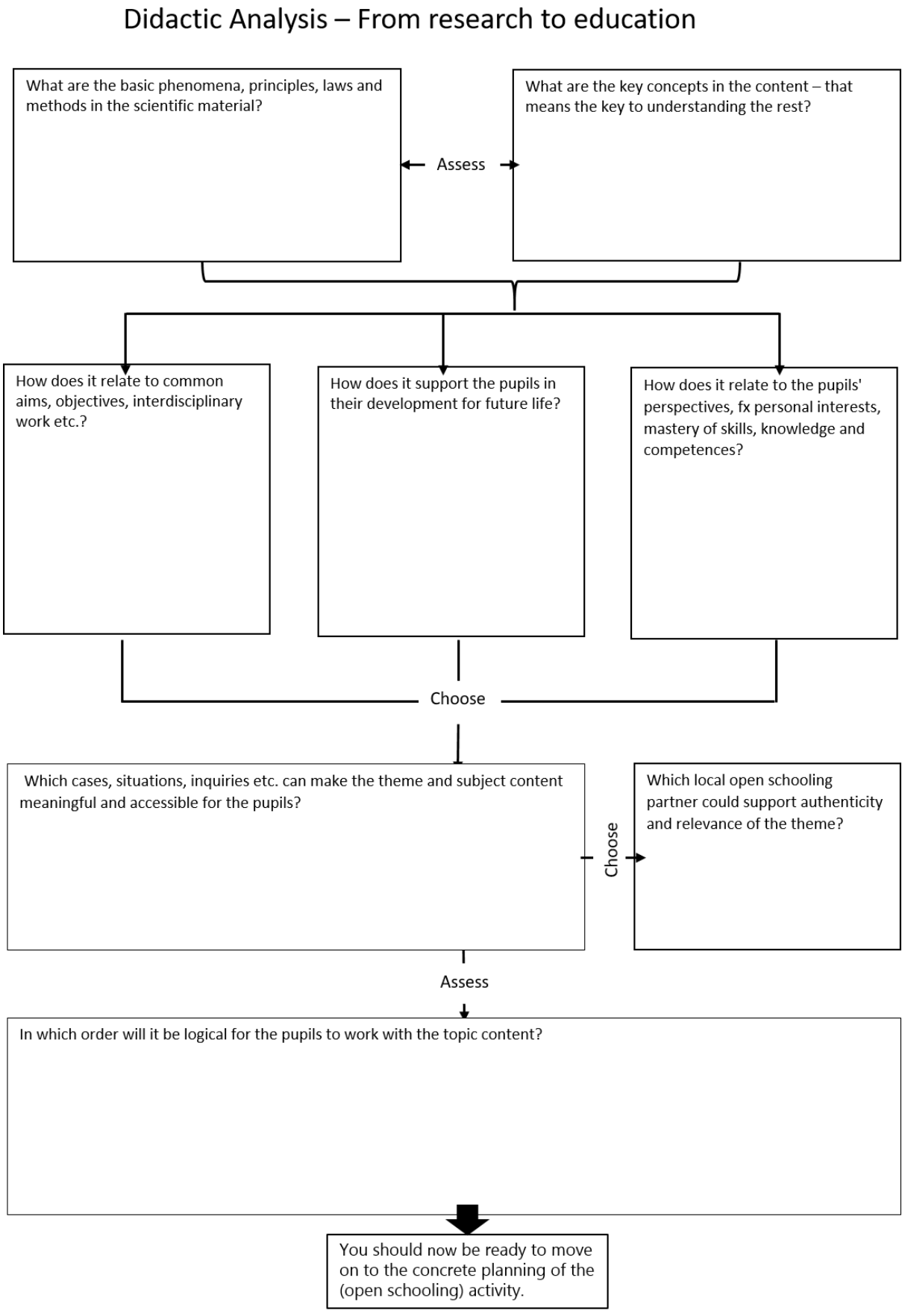
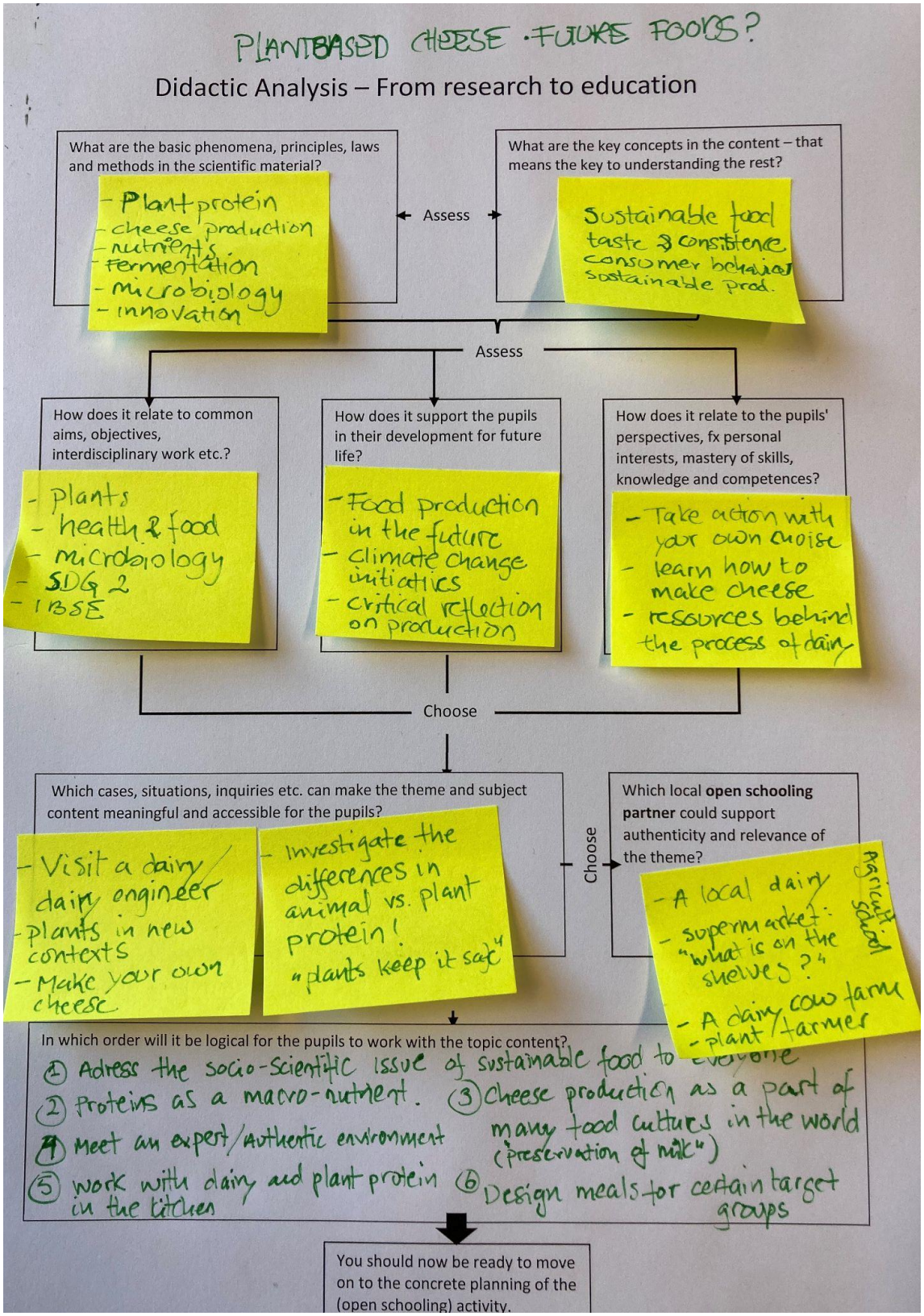


FIGURE 16. THIS ANALYSIS IS BASED ON THE SCIENCE NEWS ARTICLE ON YELLOW PEA PROTEIN



21st century skills

Training activity 3 (70 minutes)

Introduction

21st century skills is a term that has been widely used for the last decade. Maybe it has often been used without much reflection on how these 'skills' are being set into action, and how we find a common language to discuss this. *I can think! I can be creative! I can talk and listen! I can collaborate with others!* What goes prior to the point where pupils can actually state these sentences and know what it means? It is an important task for the facilitators of their learning. Often, a teacher takes this role, and hence it is worth practising how to assess and give feedback on the development of these skills among the pupils.

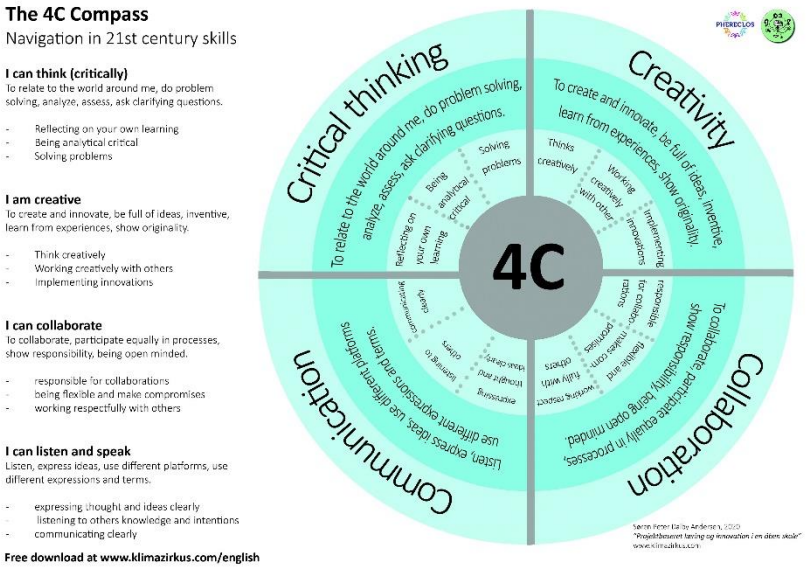


FIGURE 17. THE 4C COMPASS

The skills are central traits for pupils to master, as they are ever closer to taking the role of active and engaged citizens in a future where the problems to be solved are interdisciplinary and they are being educated to professional roles that we do not necessarily know the names of…just yet. As experts from the National Academies of Sciences states, "The education system will need to adapt to prepare individuals for the changing labour market. At the same time, recent IT advances offer new and potentially more widely accessible ways to access education."

Purpose

The purpose of this activity for teachers is to train the participants' capacity to formulate signs of learning within the field of the four basic competencies of 21st century skills (the so-called 4C's - communication / creativity / critical thinking and collaboration). This training is meant to support the participants' reflection and assessment of pupils' skills and establish the basis of a common language. The 4C skills are not supposed to be treated separately in everyday use since there is overlap between their domains. In this activity however, we choose to divide them up, for the sake of simplicity.

Aims and goals

The teachers will train their ability to choose a few, or just one competence at a time to focus upon in the development of pupils' 4C skills. They will specifically work on ideas for:

- Monitoring/tracing the pupils progression over time
- Identify attained learning goals and identify new development opportunities
- Create a dialogue among peers of how the pupils are provided with the best learning opportunities to develop 4C-competences.

Success criteria

The participants:

- Have chosen a single '4C competence' to delve into
- Discuss and attain at least some common understanding of how the 4C competence can be described and defined overall in an action-oriented manner.
- Have made a small catalogue of observational 'signs of learning' that relate to the concrete 4C skills
- Define an age target group, since e.g. critical thinking is typically expressed differently at the age 7, 12 and 16.

Description

The activity consists of the following phases:

1. Get your C
2. Delve into the sea of skills
3. Group visit
4. Search for signs of learning
5. Create a visual product of the definitions and coupled signs that relates to your 'C'
6. Make a short presentation and give feedback to each other

1. Get your C (2-5 minutes)

Make groups of 3-5 people and give them a random competence from the 4C compass to work on. In the end, all C's should be represented. It does not matter what C they work on, since the work method will be the same no matter which one they choose.

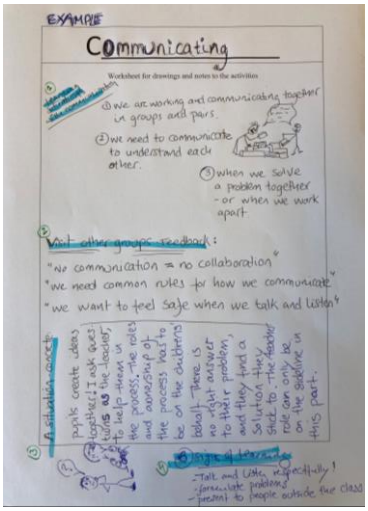


FIGURE 18. EXAMPLE OF A WORKSHEET

2. Delve into the sea of skills (15 minutes)

The groups are now supposed to go deeper into the competence and create their common definitions of skills/ coupling competences that lie within this domain. They can use the three definitions from the 4C compass to get started by elaborating together:

Guiding sentences of generic character:

- What does it mean to think/be **collaborating/communicating/creative/critically**?
- Describe a situation where you are **C-ing** with others.
- Create one or more **sentences** that describe a professional context where your **C** is in play. It could be: "*When I read about climate change, I am critical about the source of the information*".

3. Group visit (5 minutes)

Each group will now prepare to send out agents to visit the other groups. One person will stay at "home" to present the work and the sentences created in this group.

Agents now disperse out to the other groups to cover as many as possible (One agent per group visit).

The task for the outgoing agents is to listen, and the agent has the possibility to ask questions after the short presentation. There is no room for sharing opinions or giving advice. Only questions can be asked.

When agents return to their group, they do a one-minute briefing of the acquired knowledge from their visit.

4. Search for signs of learning (15 minutes)

Now it is time to describe what 'a sign of acquired learning' within your **C** will look like based on your written answers of the sentences and the gained knowledge from visiting the other groups.

As an example:
How can you describe a situation that will show that a learner is being critical in the analysis of a text or information provided?

Suggestion on a sign of learning:
The pupils question the source of the information and seek further information of the background of the author.

Create as many signs of learning that you can come up with based on the action-oriented sentences.

5. Create a visual product that relates to the outcomes of your 'C' (5 minutes)

You may use the 4C template to wrap up the outcomes of your group work, so it can be ready to be presented. If you have the time, it is also a good idea to create your own visual product of the competence work.

6. Presentation and feedback (10 minutes, 5 minutes each)

Team up with one other group, preferably with a different C than yours, and present the action oriented sentences as well as the connected signs on learning (2 minutes).
Let the other team ask questions to the product as well as the process that lies behind (3 minutes).
Switch roles and repeat.

Materials

- 4C templates - can be found in the attachment below
- flipcharts
- markers
- sticky notes

Signs of learning

The following sign of learning could be relevant to assess in a post-activity feedback session:

- change of language during the session and use commonly achieved definitions on terms,
- disagreement and discussions on definitions and important signs of learning, backed up by argumentation and listening.

References

National Academies of Sciences, Engineering, and Medicine. 2017. Information Technology and the U.S. Workforce: Where Are We and Where Do We Go from Here? Washington, DC: The National Academies Press. doi:10.17226/24649.
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Andersen, S.P. D. (2020) Projektbaseret læring og innovation i en åben skole - Praktisk og teoretisk guide til PBL. Forlaget Klimazirkus - Building Workshop.

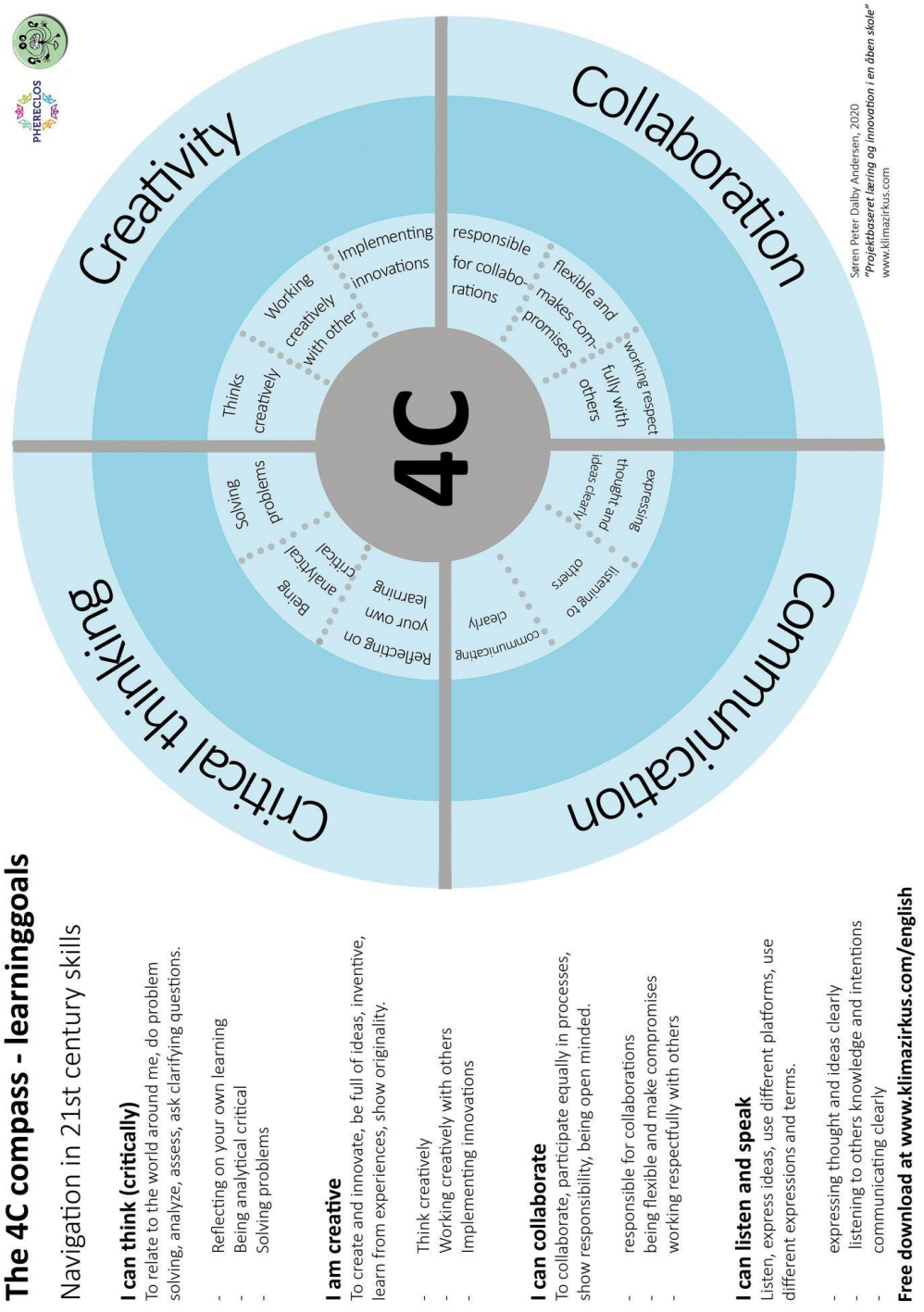


FIGURE 19. 4C COMPASS WITH BLANK FIELDS TO FILL IN.

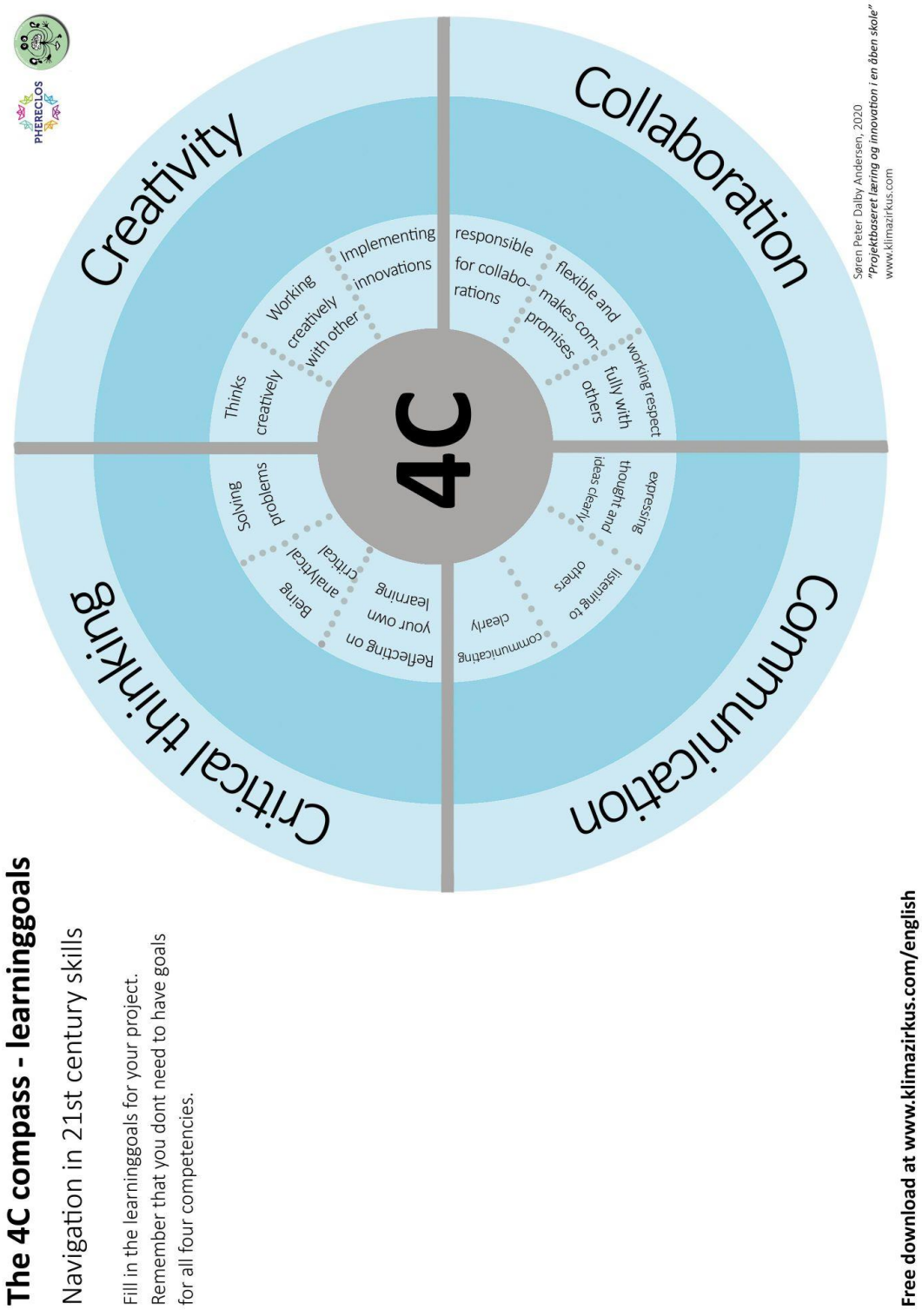


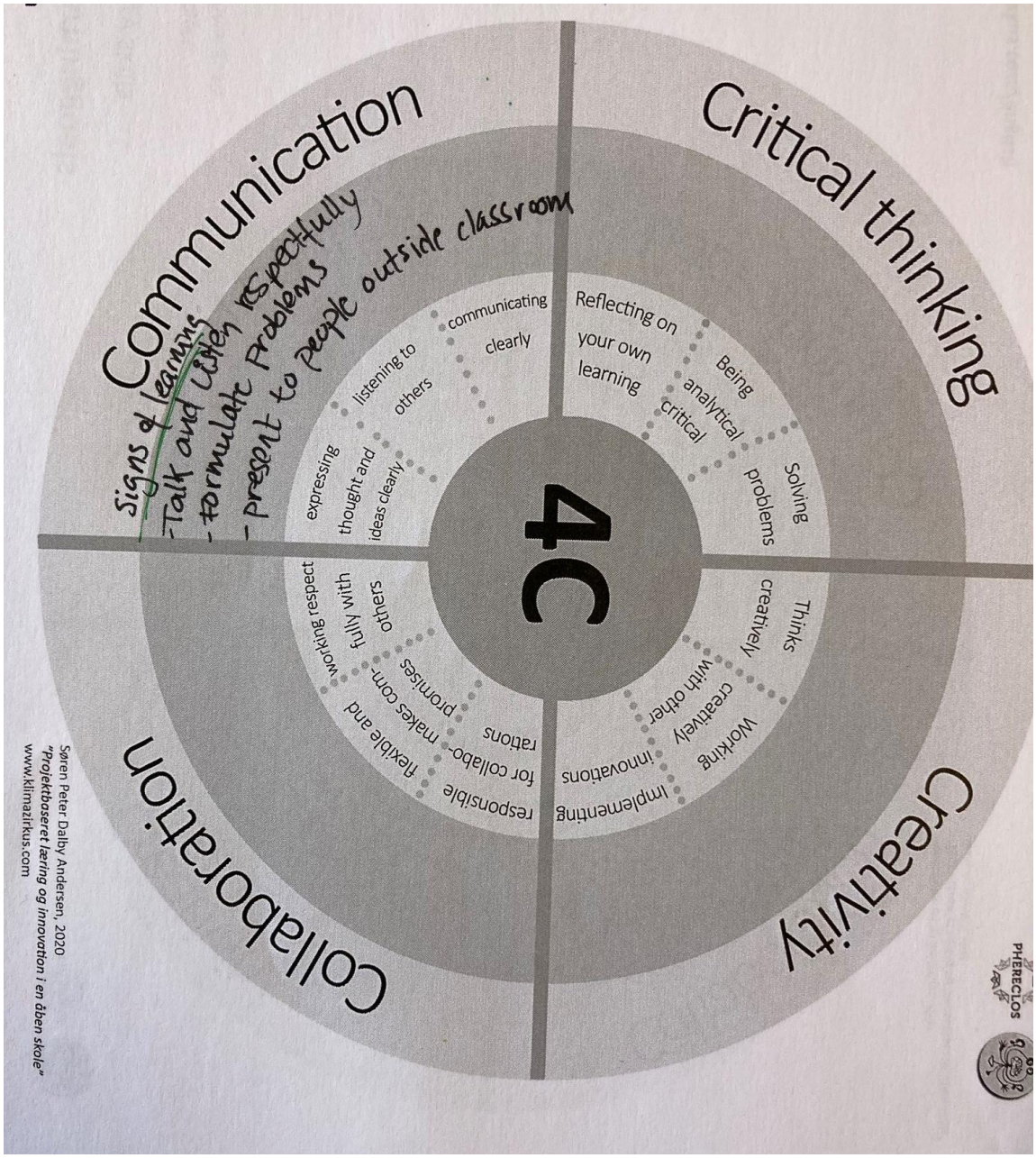
FIGURE 20. 4C COMPASS TEMPLATE WITH MORE BLANK FIELDS TO FILL IN.

FIGURE 21. BLANK 'C' WORKSHEET TEMPLATE

C_____

Worksheet for drawings and notes to the activities

FIGURE 22. EXAMPLE OF A WORK PROCESS WITH A 'C' FOR THE 4C COMPASS



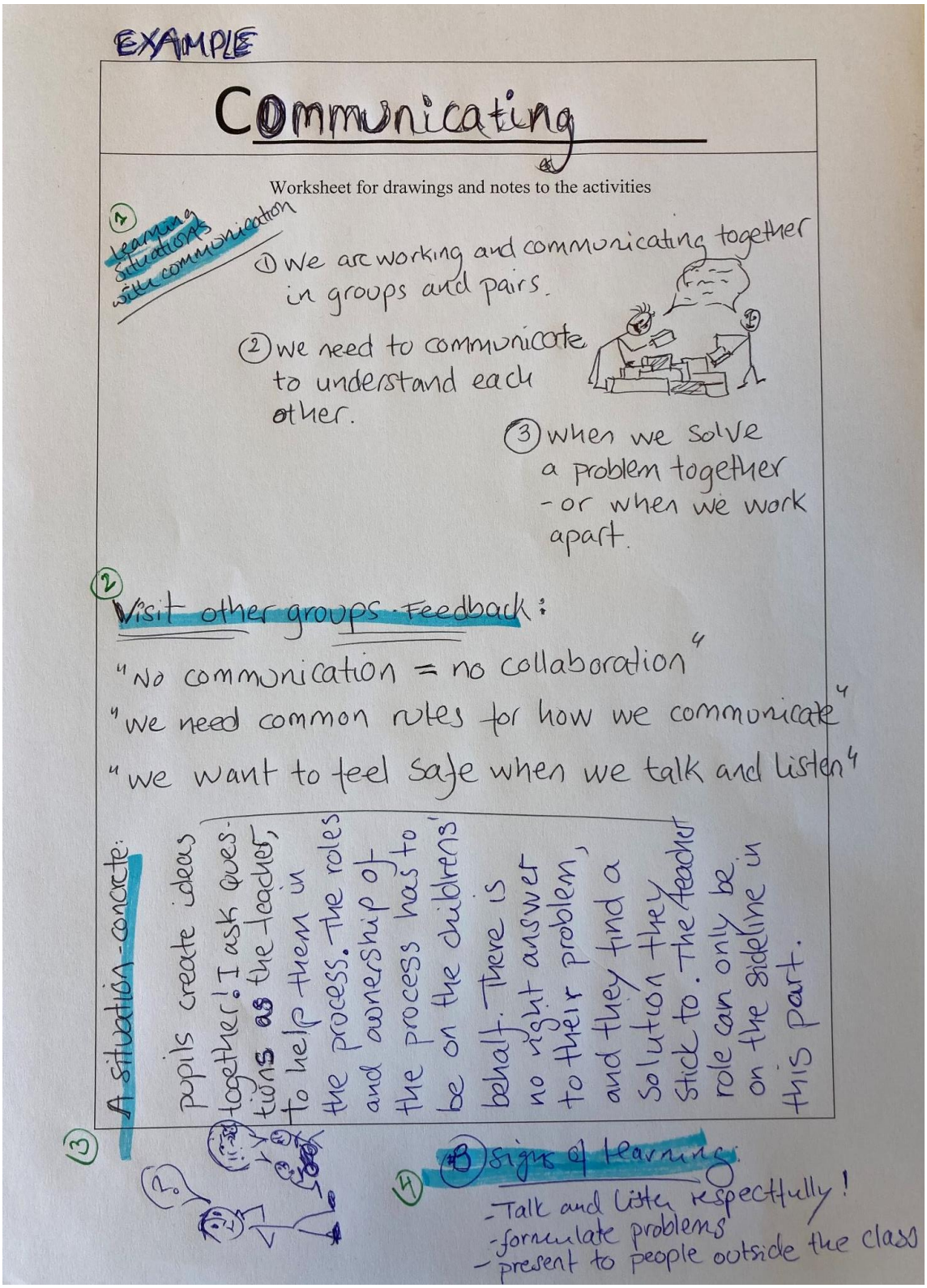


FIGURE 23. EXAMPLE OF THE 4C ROUND TEMPLATE IN USE.

A design challenge

Training activity 4 (120-180 minutes)

Introduction

Authentic problems in school situations that are challenging pupils to develop suggestions for solutions is a qualified way of pushing the autonomy and ownership of the learning process towards the learner. A design process like this should draw on competences from creativity, innovation, critical thinking, collaboration and communication in order to become successful. Training the courage to try, fail and try again, when you search for solutions is also a competence that is important in this design thinking domain.

Defining problems and designing solutions, can challenge people to be creative and innovative, but also systematic and structured. This activity is based on a design thinking method called "Double Diamond" that was introduced by the British Design Council in 2005, and is today used by a diverse spectrum of people, from professional designers and engineers to university students and schoolchildren. A design challenge could easily be introduced in a context after a more science oriented methodology, where an inquiry has led to a new understanding of a phenomenon, problem or causality.

The alternation between divergent thinking and convergent thinking is key to create choices that can be the foundation for making choices. Divergent thinking is about creating ideas and choices by using creative and nonlinear methods, where convergent thinking is about making choices, more based on structure and logical reasoning.

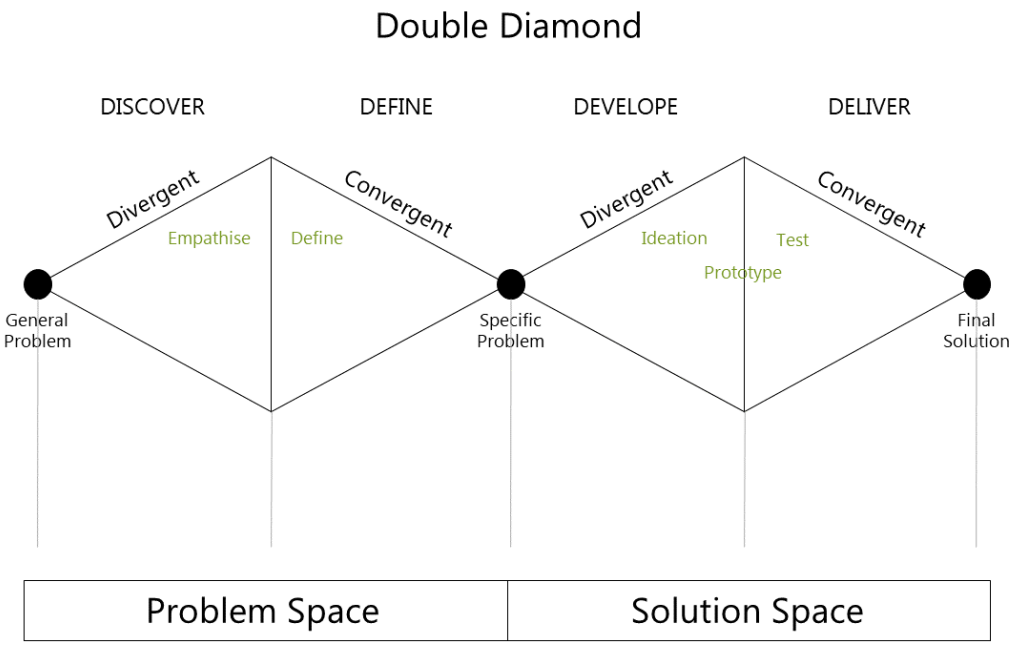


FIGURE 24. THE DOUBLE DIAMOND MODEL (BRITISH DESIGN COUNCIL, 2005)

Natural scientific methodology is suitable for gaining new knowledge and understanding, but not for creating solutions to human centred problems. This is where we turn to the divergent and convergent phases in the problem space and solutions space. At least when it comes to the double diamond model. Hence, the methods can supplement each other in the pupils' toolbox for working with authentic STE(A)M oriented problems and activities. The complexity of a design process needs to fit the development level of the pupils. The younger the target group the simpler the problem and methodology should be applied! Starting with the youngest children, fewer steps and less abstraction in the design process is preferred.

Purpose

The purpose of this activity is to train the participants in planning and using the "Double Diamond model" as an example to facilitate design process activities with their learners/pupils. Furthermore, it is the purpose to introduce exemplary supporting methods fits the work in the four major phases of the double diamond process. This to support the divergent and convergent processes that alternates through the design cycle from general problems to a specific solution to a specific problem. In this case, we will work with a design case that can be processed without a great demand for materials or infrastructure.

Aims and goals

The participants,

- work in groups with a design challenge from a catalogue, or bring their own challenge aboard, where they define a general problem to work with
- follow the model steps and try out suggested methods in progression of phases
- come up with prototypes, test and improve them
- train their ability to work with a divergent mind set
- train their ability to work with a convergent mind set
- make a presentation of the process and product, that focuses on own learning on the methodology in practice

Description

The design process is divided up in four overall phases

1. Discover (divergent thinking - what are the possible causes to your problem?)
2. Define (convergent thinking - what single cause should we aim at solving?)
3. Develop (divergent thinking - what are all the possible solutions to this problem?)
4. Deliver (convergent thinking - what is the best solution to this problem?)

The challenge can be given from an overall question or general problem that is to be explored freely by the learners, or it can be more teacher structured, so that the problem is more narrowly defined.

Possible topics for design challenges:

1. How can all sixth graders in school feel motivated to be more active in their breaks? (Example in the appendix)
2. Can nature inspire us to make inventions that make our lives better?
3. Can our garbage from school/home become gold?
4. Can school meals be tasty, cheap and sustainable at the same time?
5. How can we help children that do not like to fall asleep?
6. How can we learn about our future work life?

A more narrow design challenge:

7. Can you create a device that can protect a fragile device when accidentally dropped to the ground?
8. How will you create a wearable design that tells a story about the person wearing it?
9. How can the school become a better place to be physically active in?

DISCOVER (30 minutes)

What are all the possible causes of this problem/challenge? In general, this phase is for opening up the problem and exploring in creative ways and retrieving impressions and inputs.

Methods

In this phase, you can explore the problem to come closer to an understanding by

- create a persona for whom the work group can put themselves in that position in order to map the situation, challenges and behaviour of the target group for the design solution
- making interviews of experts or people of interest for the problem
- research background articles on the topic
- a brainstorm process with a focus on all the challenges there can be within the topic

When the group has worked with one or two different methods to come closer to understanding the topic and empathising with the target group of the design, it is time to move on to the define phase.

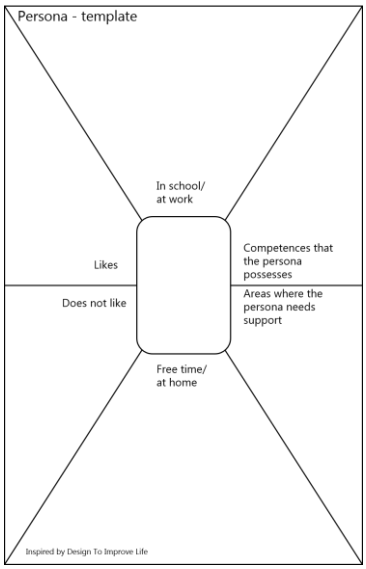


FIGURE 25. PERSONA TEMPLATE FOR A HUMAN CENTRED DESIGN PROCESS.

DEFINE (20 minutes)

Now the general problem has been explored and the target group analysed, it is time to narrow in the general problem to define a specific problem to work on. Since you cannot improve or work with all the discovered problems at one time, you have to make choices.

Method

In this convergent phase, the handling of the data and knowledge generated in the discovery phase can be structured in several ways. In this situation, the use of a mind map is suggested. This can help structure all the knowledge gathered in the latter phase into a collective construction.

Steps:

- Start by writing the challenge or problem on a sticky note in the middle of a board or flip chart. Then write down the headlines of the gathered info and acquired knowledge in the way that it connects to the problem.

- When this is done, start discussing where the most interesting problem is positioned and point out these places.

- Single out these important key points and discuss which one you choose to work on. If there is more than one obvious candidate, you still need to choose only one to continue.

DEVELOP (40 minutes)

Now one single problem is defined and the search for solutions is up next. In the development phase, the aim is to come up with as many suggestions to solutions as possible. Research on creative processes point towards that quantity in idea generation is the most important factor in order to ideate new and innovative solutions. Hence, the focus here will also be on idea generation quantity.

Methods

In this phase, there are several relevant methods to support the generation of solutions. This activity presents only two different possibilities to choose.

Brainstorm

As a facilitator, avoid coming up with ideas or judging the ideas. It is the participants who must generate ideas. The very quality of the ideas should be tested with users and other actors outside the teacher-training forum.

1. Ask participants to reformulate the problem or goal as a solution-oriented sentence starting with "How can we…", e.g. "How can we find relevant materials for shoes inspired by nature?" (5 minutes)
2. The participants now choose the best "How can we…" phrase. (2 minutes)
3. The rules for brainstorming are then presented (5 minutes):
    a. Do not judge your own or others' ideas
    b. Go for quantity
    c. One conversation at a time
    d. Encourage wild ideas
    e. Build on the ideas of others
    f. Maintain focus on the topic
    g. Be visual (and document)
4. Participants now write their ideas down on post-its, and place them on flipcharts. Feel free to give them a time limit (for example 5 minutes) so they do not have time to censor themselves too much. Quantity is above quality in this session.
5. Reverse brainstorm: To twist the process a bit, now give the participants the task to come up with the worst ideas for solutions to your problem in the next 5-10 minutes. Simply because, it can boost the idea generation to another level when it seems to be stuck. This twist can also contribute to the amusement and general group atmosphere, since some "worst ideas" really are silly.
6. The participants now take some of the worst ideas up, and try to remodel them into usable ideas. This process can be given time as long as there is a sense of momentum in the individual groups.
7. The time is now for analysing the ideas that have been generated and merging the different suggestions and ideas that somehow have similarities. Do this by grouping sticky notes with common content.
8. Use 5-10 minutes to rewrite the merged ideas into a common sentence.

Rapid prototyping

This method works best if you have already generated a pool of solutions,
The idea is to visualise ideas to solutions in a fast way by making physical prototypes. It is important that the participants do not worry about aesthetics, since it is only about creating models for discussing the value of different solutions.
Steps:

- Choose the solutions that needs a prototype (at least three or more)
- Choose the materials for building the prototypes
- Set a time limit for working on each prototype (e.g. 2 minutes)
- Present the prototypes to someone outside the group
- Move on to the phase DELIVER, or go back and make new prototypes after evaluating and testing the first generation.

DELIVER (30 minutes)

The creative phase with generation of ideas and prototypes is now being taken over by a convergent process of choosing the best solution for the specific problem.

The Matrix

Matrix is a method for assessing the value of the solutions your group has developed.
Criteria for assessment should always be adjusted to fit the nature of the solutions or prototypes. In the example, the focus is on finding new shoe materials that are inspired by nature. Hence, the criteria could also be on easy/hard to use in a sustainable way or little/great value for changing consumer habits.

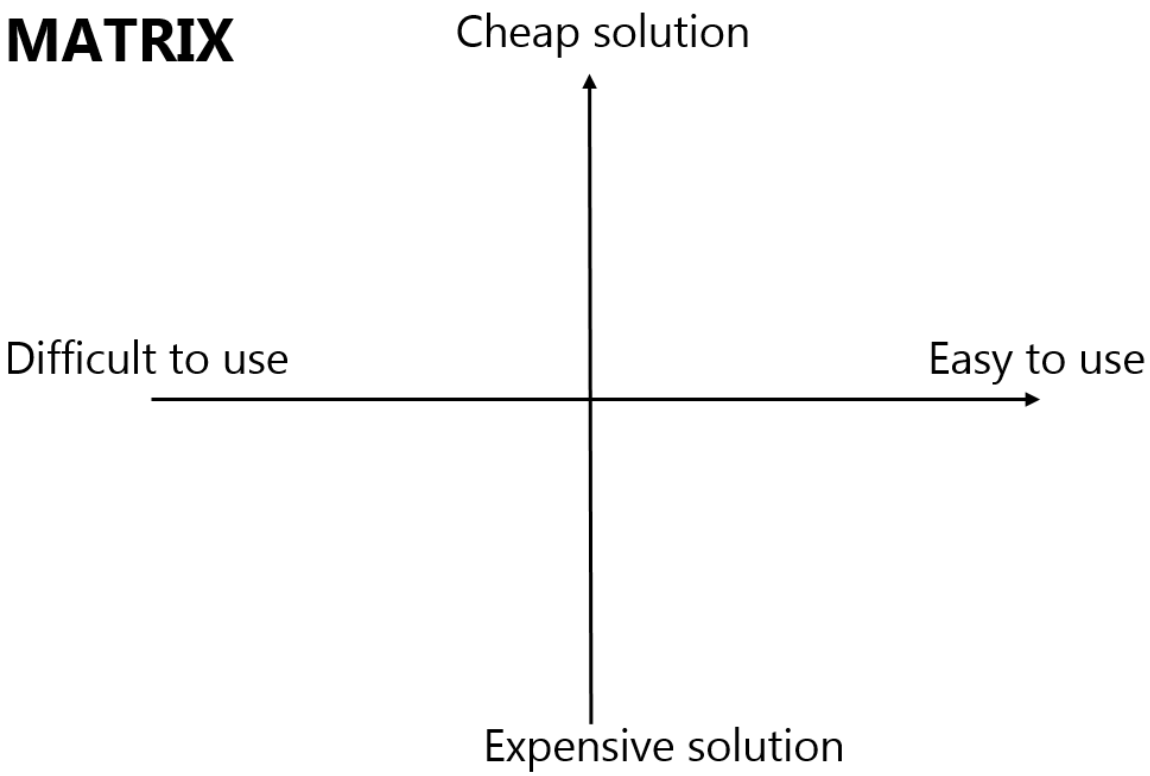


FIGURE 26. EXAMPLE OF A MATRIX FOR ASSESSING SOLUTIONS. THE AXIS VALUES CAN BE CHANGED TO FIT THE SITUATION

The purpose of this activity is to single out the best solution/prototype from all the solutions that was generated in DEVELOP.
Steps:

- Think about what criteria that could be relevant for sorting the solutions/prototypes in terms of the concrete problem you are working on.
- Choose two criteria and draw a matrix like the example above.
- Write down all the generated solutions on sticky notes and place them in the matrix according to how they are evaluated.
- Discuss whether you only want to work with solutions from one specific quadrant or more than one.
- Reflect: Are there solutions that could be moved?
- Pick out the best solution according to the criteria.
- Make a very short pitch on your solution (60 seconds).
- Present your solution to the neighbour group and receive feedback

You can now choose to refine this solution or take it back to the beginning and start the DISCOVER phase with focus on this specific solution. Simply to delve deeper into this matter.

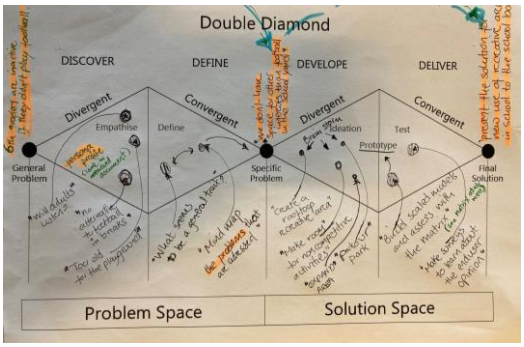


FIGURE 27. EXAMPLE OF A DOUBLE DIAMOND PROCESS

The Double diamond is not a linear process. It is possible to go back to prior phases or start over again in a new iteration. If there exists a need for coming up with other solutions or prototypes in order to make a qualified choice, this could be an option. It is also worth remembering that time is a factor.

Materials

- Printed Double Diamond model - in A4 or A3 (see appendix)
- Flipcharts
- Markers
- Sticky notes
- Optional: All kinds of crafty materials to build prototypes

Signs of learning

The participants,

- use the terminology that describes the different elements of the Double diamond process
- go through a whole design process circle
- reflect on the connections to science related topics
- make a presentation that emphasises the learning achieved and where to train more

References

https://innovationenglish.sites.ku.dk/model/double-diamond-2 / (accessed July 7th 2022)
https://innovationenglish.sites.ku.dk/metode/rapid-prototyping/ (accessed July 7th 2022)
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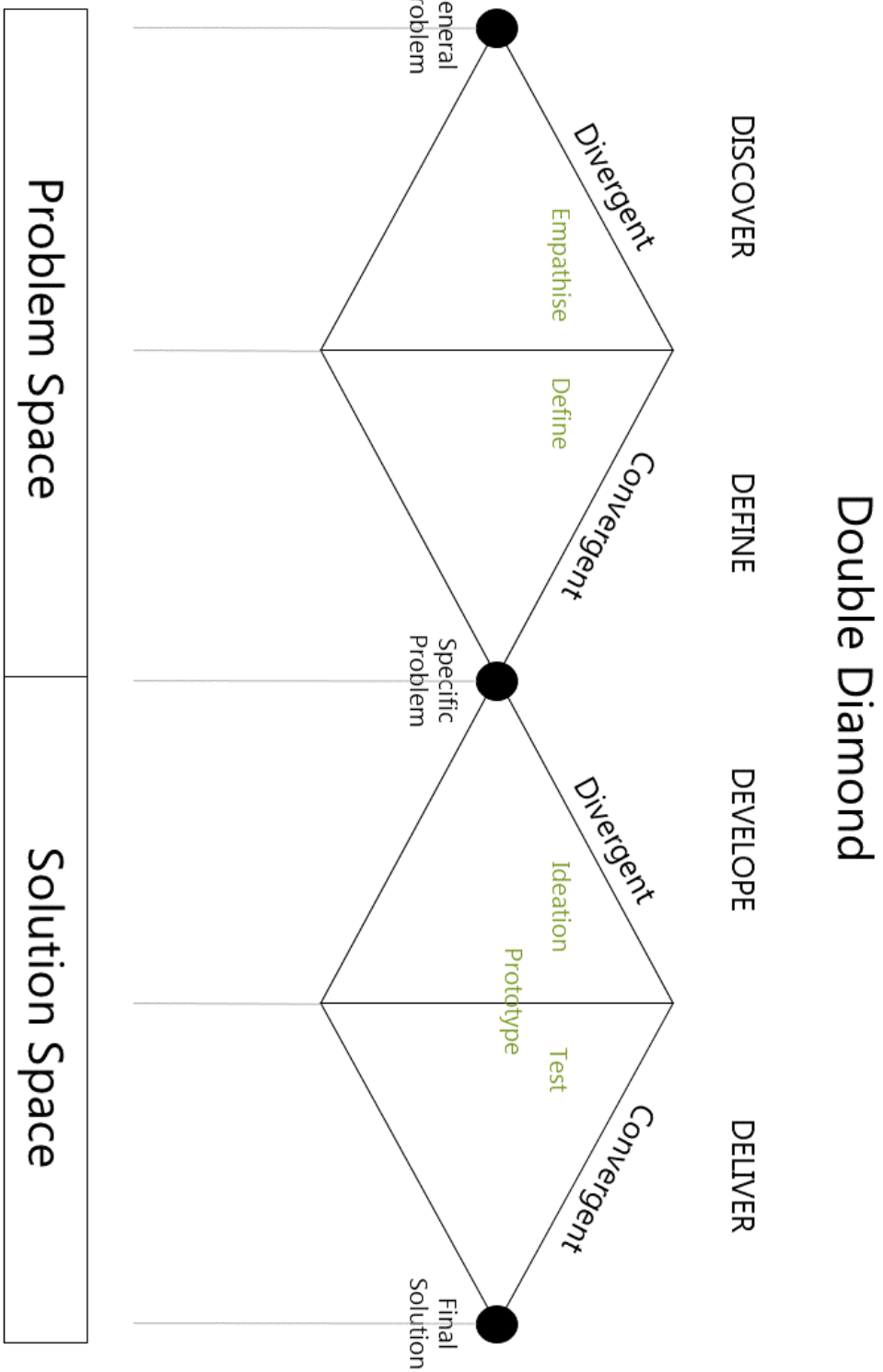


FIGURE 28. DOUBLE DIAMOND TEMPLATE

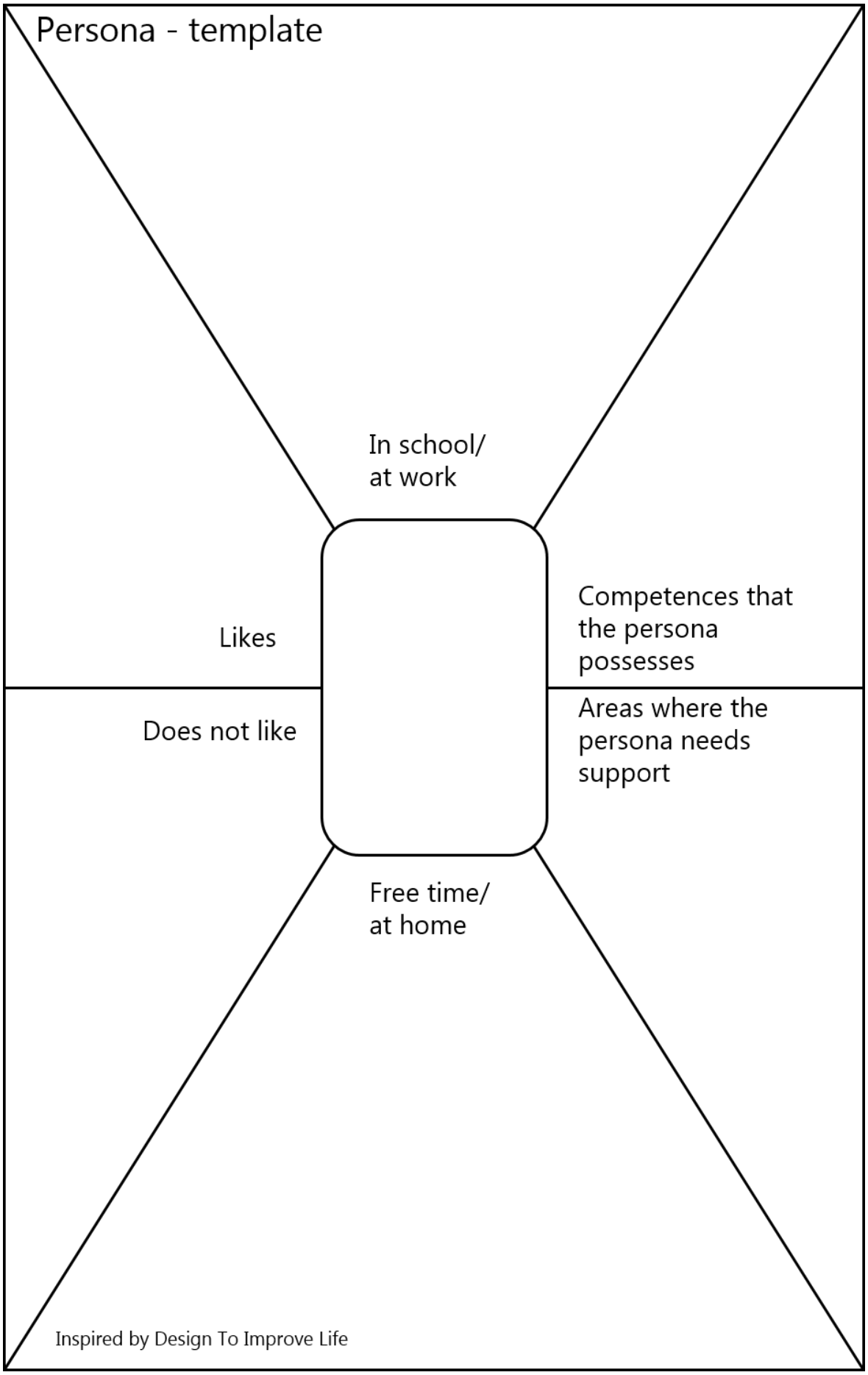


FIGURE 29. PERSONA TEMPLATE

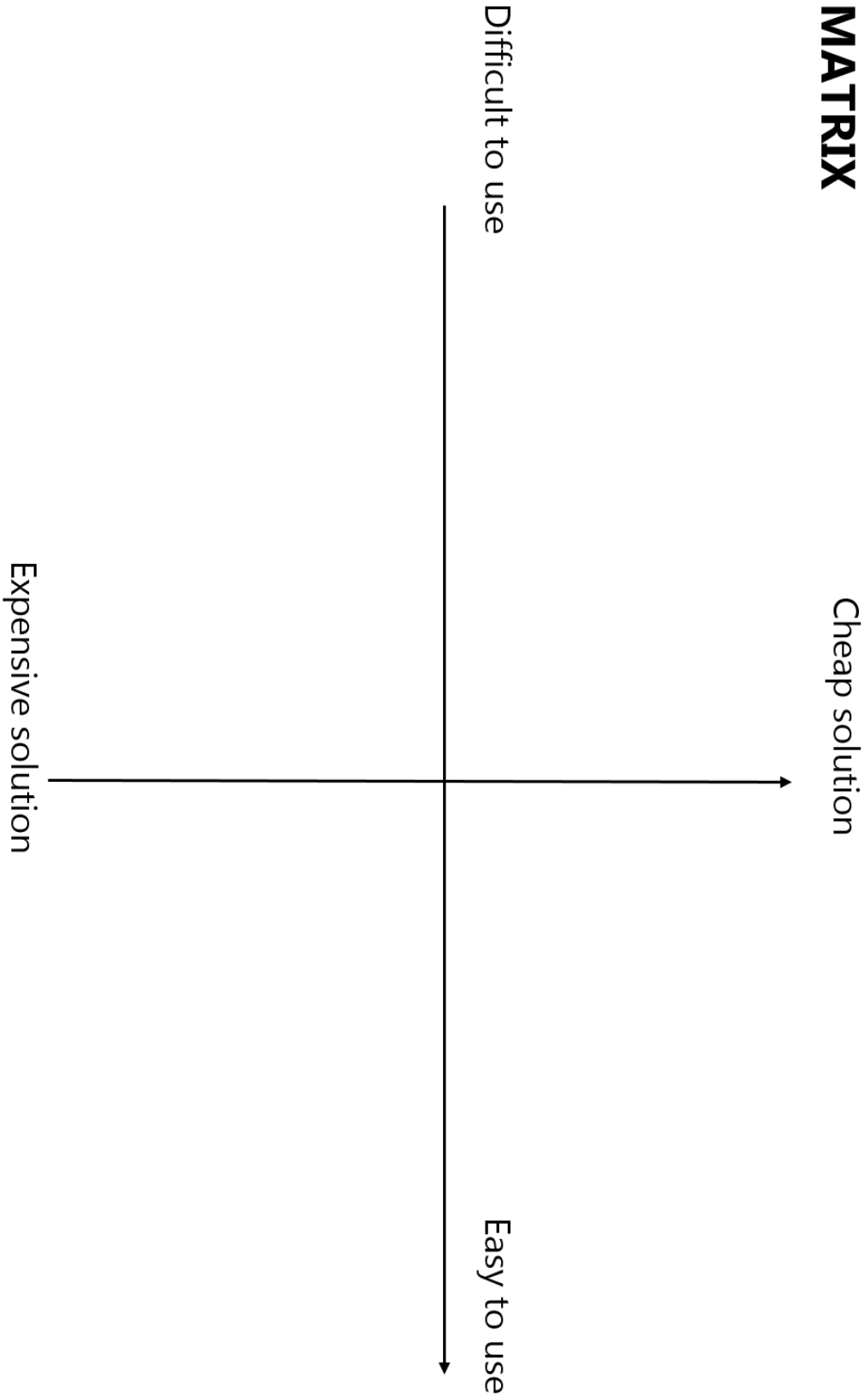


FIGURE 30. MATRIX TEMPLATE

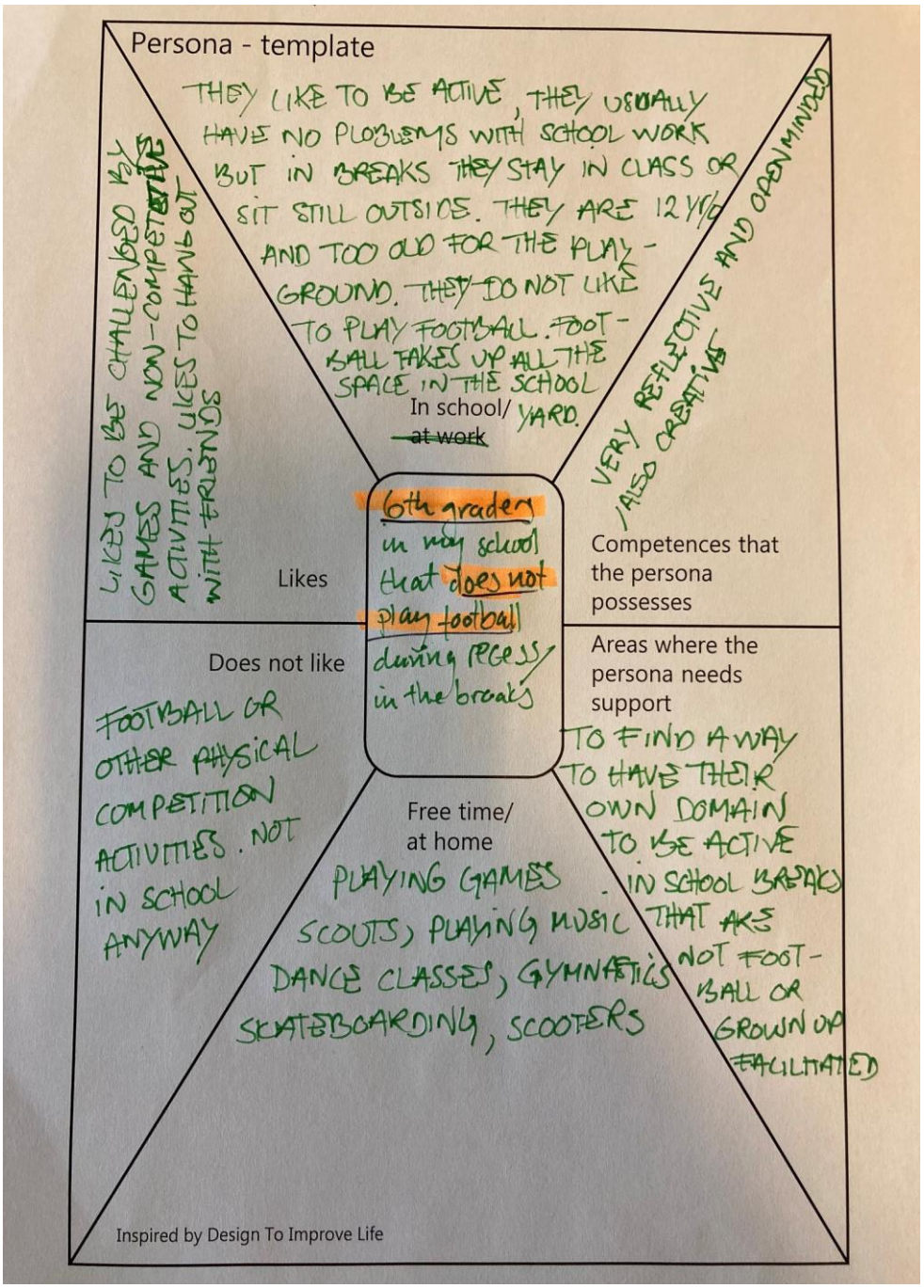
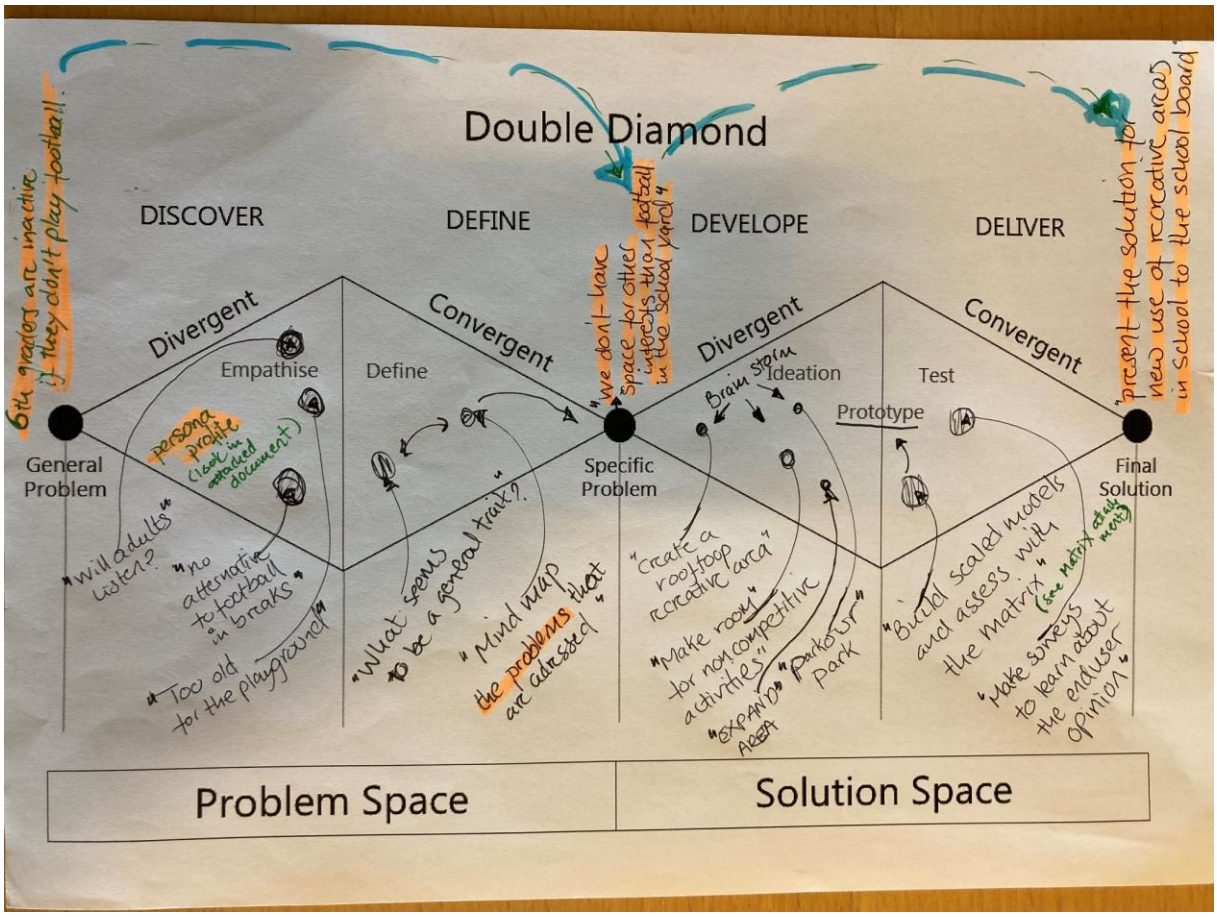


FIGURE 31. PERSONA TEMPLATE EXAMPLE



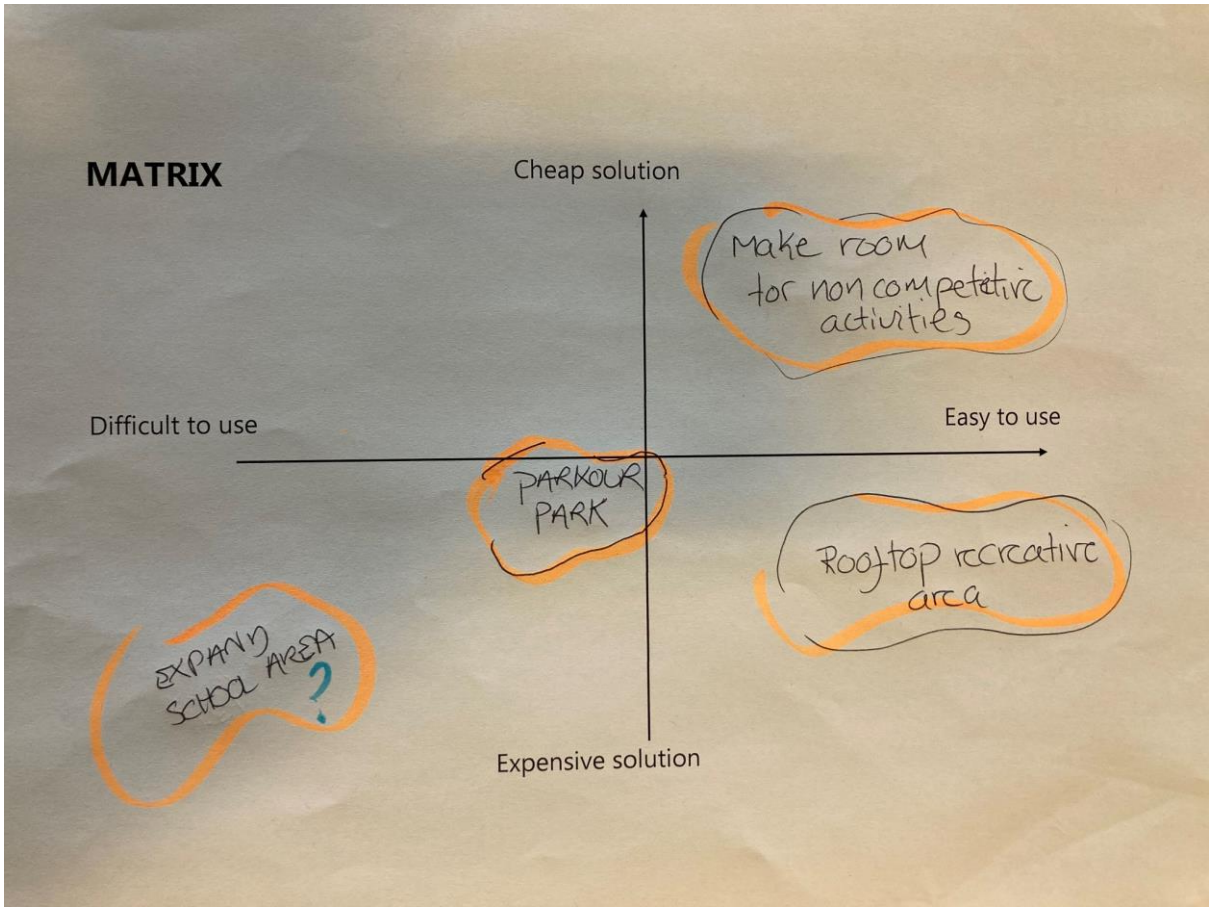


FIGURE 32. DOUBLE DIAMOND AND MATRIX TEMPLATE PROCESS EXAMPLES

An inquiry
Training activity 5 (120 minutes)

Introduction
Inquiry based learning, and inquiry-based science education (IBSE) has proven a very qualified strategy for introducing a more participatory approach in STE(A)M education. This activity will challenge the participants to convert a classical science lab experiment - cookbook recipe style, into a qualified inquiry-based structure, that raises the level of the learners' autonomy in the activities.

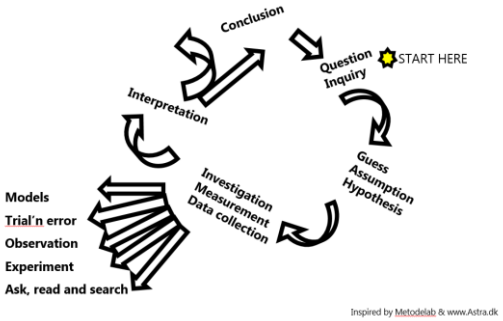


FIGURE 33. METODELAB MODEL

Furthermore, will the search for authenticity in the science inquiries make integration of external partners and also learning environments seem more obvious as elements in the educational planning and design. This activity has focused on inquiry-based learning and it will be up to the facilitator to decide how to connect it to an Open Schooling context that fits the local context.

Purpose
The purpose of the activity is to train the participants to think in an inquiry-based learning structure when they are planning STE(A)M Open Schooling activities. The starting position in a classic science lab experiment is also done with the intention of training from a known field that can actually be redesigned into a different and more learner centred format.
The purpose is furthermore to assess whether some process steps should be more structured and other open in terms of the pupils autonomy and mastery of the scientific method.

Aims and goals
The participants
- work with the inquiry-based format in order to convert the original activity step by step
- actively uses the terminology from IBSE in their professional discussions
- make choices of which general didactic IBSE design they use as template
- consider whether to apply graded autonomy through the different phases of an inquiry cycle

Success criteria
The participants
- come up with suggestions to an activity where learners need to assess and decide more elements themselves
- also consider a design where the risk of failure is greater and is accepted as a part of the iteration
- have focus on the opportunity for collaborating with external partners in or out of the school to support authenticity of the theme is integrated in the learning design.
- incorporate strategies where different level of autonomy are considered

Description
Method: An inquiry - in six steps by Metodelab

The circle in the MetodeLab model (Kofod & Tougaard 2014) is a simplification of a scientific process. It goes from single surveys to scientific knowledge and insight. Ideally, the scientific process starts with an inquiry that is being reformulated into a hypothesis. The hypothesis or the presumption is pursued in an investigation, which results in a form of data. This data must be processed and interpreted, so that one can answer the

question and draw conclusions. The conclusion ends the process or can then lead to another inquiry and the iteration in the model starts over (Astra 2015).

The single steps in the circle can be adjusted in autonomy in order to both support and challenge the pupils with the amount of complexity that fits them best. Read more about this in the next section.

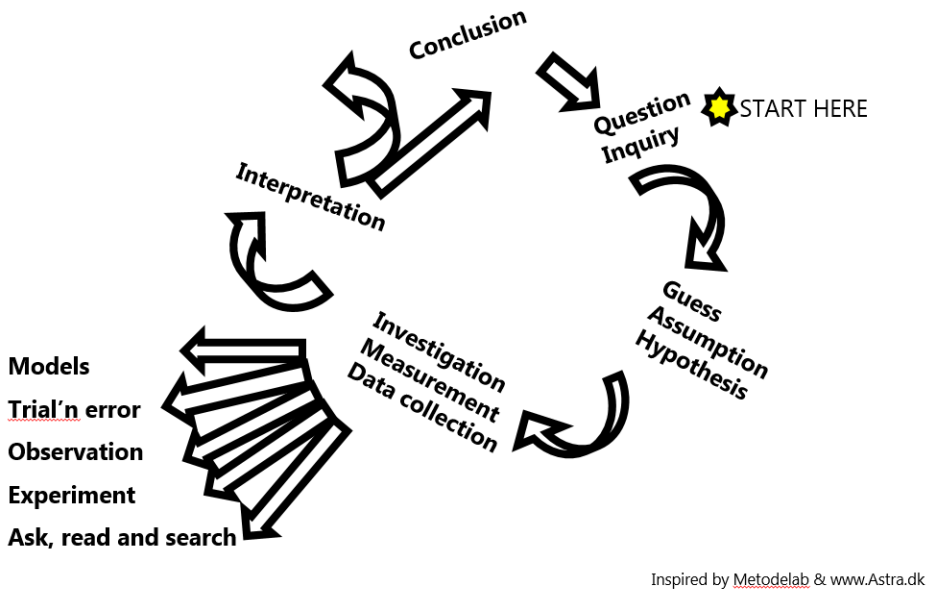


FIGURE 34. METODELAB INQUIRY BASED SCIENCE LEARNING MODEL

In a quick run through of the model, there will be short suggestions on how to work with the pupils in practice and in the perspectives of an Open Schooling collaboration.

Question or inquiry

What, why or how? What is scientific about the question?

Hypothesis

What do we expect? A proposed explanation of the science question. A hypothesis is never a question.

The creation of a hypothesis can be tricky in itself and hence it is a good idea to train this skill. How to convert questions into hypotheses in a form so that they can be investigated.

With younger pupils, it can be fine just to make qualified assumptions or guesses that will be tested out in the design of the data collection or similar.

Design the investigation

What method to use, where to set up, what materials to use, which variables are the central ones, which are constants and in what order to perform the elements of the method.

It is important to be aware of the resources at hand. Especially if the empirical work or research will be done in an informal environment outside school. Good communication and agreements with external partners in this phase is very valuable, since new equipment, settings, knowledge, and expert advice can come into play and affect the choices the work groups make.

Investigate

Collect data, observe change and development, dissect and disassemble, measure physical change and manage all data.

Here are several methods to choose from and it should have been decided already in the design phase. It is important for the groups to be systematic in the collection, and take action when they experience that their plan does not turn out as expected.

"What would you do if you want to look at stars but it's cloudy that night?"

Interpretation - Analysis

Analyse data and results, systematise data and results, interpret and compare them

How do the findings support or differ from the hypothesis or assumptions? Is there a good method to analyse the results or sort them? In a spreadsheet? In a diagram? In a model?

Conclusion - end it or refine

Suggest answers and pick up on results. Conclude on the connection between scientific question and hypothesis and results. Confirm or reject the hypothesis.

Make a statement that defines whether the hypothesis is supported by your analysis, should be discarded or maybe just is inconclusive. Maybe there is a need to go back and reflect on the experimental design, and redesign, in order to get clearer results.

EXAMPLE:

Brainstorm for initial questions for an inquiry, inspired/brainstormed from the picture.

(Continue the brainstorm, use a different picture or pick a question from the list to elaborate):

Why does everybody not like broccoli? *(Collaboration with food scientists or cooks)*

How was broccoli invented? *(Collaboration with plant breeder, horticulturist, vegetable farmer)*

How do wild plants protect themselves from being eaten? *(Collaboration with nature schools or botanists)*

Can you measure toxicity? *(Collaboration with environmental chemist, pharmacy or similar)*

What did our ancestors do when they became ill? *(Collaboration with historians, local museum, online lectures from university researchers)*

FIGURE 35. INSPIRATION PICTURE OF BROCCOLI

When was medicine invented and how does it work? Maybe a specific type of medicine *(collaboration with health historians, medicine chemist or the local pharmacist)*

Question or Inquiry

Example:

Choice of example from above: Can you measure toxicity?

Investigate and explore the question before you move on:

What is the definition of something toxic? Is it the same for everyone? Is snake poison and plant poison the same kind of poison? I have heard that some poison is also medicine. Is it true? In our quick research, we found an experiment that can test toxic stuff by using cress seeds - maybe we can try this to test if alcohol is toxic.

Hypothesis

Example:

From a talk with a teacher, the pupils may come up with this hypothesis below. Maybe the hypotheses will be doomed to be rejected from the beginning, and it is up to the teacher where the balance between trial and error and helpful guidance should be.

“Alcohol is toxic to living things and it can be measured on plants' ability to sprout when exposed to this.”

Design the investigation

The experiment/investigation design part can be teacher structured, guided or totally pupils driven (training activity 6 addresses how to variate the autonomy).

***Example*:**

"We think that adding different amounts of alcohol to the watering of cress seeds can show us when there is so much alcohol that the seeds will not sprout. This is where we can measure the toxicity of alcohol."

"We want to test five different amounts of alcohol and then examine where the seeds didn't sprout."

Depending on the age of the pupil scientists, the expectations for accuracy and documentation can be adjusted.

The materials needed for making the simple empirical experiment:

- 5 Petri dishes
- Cotton wool
- 5-25 Cress seeds /petri dish
- Water
- Ethanol 96 %
- Measuring beakers

The different amounts of alcohol exposure can be done by diluting the original solution.

Reflect in advance about these questions: How much structure will you expect from the groups here? A controlled dilution series (10-fold dilution)? An estimated dilution? A more loose terminology, like a lot of ethanol, more ethanol, not so much, almost nothing and nothing?

What else should the group be aware of, using growing plants as a model organism?

Investigate

***Example*:**

Here, the teacher should work with students to ask the following questions:

For how long should the experiment run? Cress is a growing organism over time. No instant magic here. Are the groups monitoring at all? Are they following a planned protocol? Their own? How are the groups documenting their findings? Logbook? Photos? Nothing?

Interpret*ation* - *Analysis*

Example:

Decide how much aid the pupils should have in this phase. Are they ready to try and analyse on their own from the beginning or will a provided question guide or teacher dialogue be more suitable in terms of making progress?
How do the findings support or differ from the hypothesis or assumptions? Is there a good method to analyse the results or sort them? In a spreadsheet? In a diagram? In a model?

Can the group analyse the data and findings? Are there any flaws or mistakes they have realised during the experimental phase?

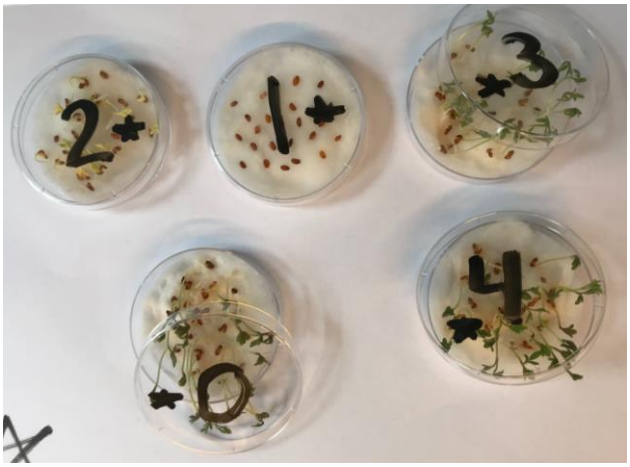


FIGURE 36. EXAMPLE OF A TOXICITY TEST ON CRESS WITH ALCOHOL.

Will the pupils continue to analyse and conclude, or will they go back to redesign the investigation and try once more?

Conclusion - end it or refine

Make a statement that defines whether the hypothesis is supported by your analysis, should be discarded or maybe just is inconclusive.
E.g., *"The alcohol in the largest quantities definitely affects the growth of cress negatively. We also need to make new solutions to find the point where the cress growth is tipping over due to alcohol in the water."*
Maybe there is a need to go back and reflect on the experimental design, and redesign, in order to get clearer results.

Perspectives:

Maybe the results are not so important in itself in the learning aims and goals. Could their inquiry-based experience be a platform for,

- Meeting an expert in the field of toxicology?
- Going on a planned visit to a farm to learn about organic and non-organic grown crops, and pesticides?
- Expanding their field of interest to other substances? They have worked with a method, now they master this and can use it in other contexts.

Signs of learning

Participants

- try to formulate questions, hypotheses that can be investigated,
- test the experimental design in practice and evaluate,
- talk about what processes that are open, structured, guided or closed, and if there also are basic, processes in the inquiry approach that are missing,
- work with the activity from an Open Schooling perspective - where are the possibilities for meaningful collaborations?

References

Kofod, L. H. & Tougaard, S. (editors) (2014). Metoder i naturfag – en antologi, 2nd edition. https://www.experimentarium.dk/wp-content/uploads/2017/06/antologi_2014_kap_1-6.pdf (accessed June 29th 2022)

Variation in science inquiries

Training activities 6.1 and 6.2

Introduction

How do you find the right balance between the competence level of the pupils and the degree of autonomy in the learning activity? The challenge here is that if you open the framework too much up and the pupils are not capable of mastering the amount of information and methods, there is a risk that they get lost in the process. On the other hand, if they are familiar with the methods in play, there is a good reason for opening the level of autonomy in the work process. No matter what, the teacher's role as a guide and facilitator, listening, and asking the right questions is still essential.

If you only want to train the ability to form hypotheses, this step of the inquiry can be opened up while others have more guidance and structure. This way the pupils' energy and focus can be on training elements of a process, instead of getting lost in an overload of information.

Purpose

By using simple experiment constructions, the participants' purpose is to set focus on the possibilities to adjust the activity design to fit certain learning aims, and the learner's level of knowledge and competencies. This activity promotes learning differentiation without having to differ in topic or subject.

Aims and goals

The participants

- become acquainted with the term, autonomy in respect to inquiry-based science education
- work with cases and reflect on how this would apply to their own working context
- consider how the step of the inquiry process should be shaped in order to work in an Open Schooling context

Materials and equipment

Activity 6.1:

- weight scales (1 per group)
- sodium chloride - table salt
- water
- glass beakers in different sizes (4-5 per group)
- potatoes (1 large per group)
- knives for cutting potatoes (1 per group)
- rulers for measuring (1 per group)
- spoons for stirring and diluting salt in the water, and testing the texture of the potatoes (1 per group)

Activity 6.2:

- A tray of eggs
- Templates for writing the outline for an inquiry-based science lesson

Signs of learning

The participants

- reflect and discuss the experiments and inquiries in terms of openness
- create diverse examples of new activities from the same inspiration
- share their ideas and listen to others' ideas
- use the template actively and consider the best choice of autonomy for each step

Description of Activity 6.1 - Osmosis and mash

Divide the participants up into groups of 2-3 persons. Each group is given one of the four different instructions for investigating the phenomenon of osmosis.

EXAMPLE 1: Open inquiry

Method:
The open inquiry is very learner driven. Within a given framework, the pupils find their own question they want to investigate and design their own experiment from where they can learn something about the topic.

Instruction 1:
Is it true that it is better to boil potatoes for mash without salt in the water?

Materials and equipment:
The group finds their own materials, which are present in the science class lab.

Example 2: Guided inquiry

Method:
The guided inquiry is less open. For example, the teacher can still ask the question, but the pupils have to find their own way of investigating it.

Instruction 2:
1. Try to investigate what happens to your potatoes when they enter salt water.
2. Pay attention to the fact that your result must be comparable.

Materials and equipment:
The group finds their own materials, which are present in the science class lab.

Example 3: Structured inquiry

Method:
The structured inquiry opens for free variables, but is still controlled by a fixed setting. The question and method can be fixed, while there are possibilities for influencing the experiment design on e.g. salt concentrations, timing etc.

Instruction 3:
1. Cut out 6 pieces of potato in identical sizes of 3x1x1 cm
2. Put the potato pieces in different salt solutions for a while
3. What happens to the different potato pieces?

Materials and equipment:
The group is provided with materials,

- table salt
- potatoes
- weight scale
- spoon
- 6 small glass beakers 100 ml

Example 4: Closed inquiry

Method:
The closed experiment is similar to what you traditionally call a cookbook experiment. The pupils receive an experiment manual that tells them exactly what they need and what they have to do.

Instruction 4:

1. Cut out 6 pieces of potato in identical sizes of 3x1x1 cm
2. Put 2 pieces in 3 different salt solution on respectively 0%, 1% and 10%
3. Take up the pieces of potato after 10 minutes.
4. Is there any difference now?

Materials and equipment: They are provided with materials,

- table salt
- potatoes
- weight scale
- spoon
- 6 small glass beakers 100 ml
- timer

Reflection in plenary after the inquiries are done

1. Which group spent the most time and why was that?
2. Compare the different approaches: Did you find steps missing in some examples in order to call it an inquiry? If so, where and why?
3. How much did the process versus outcome mean in the individual groups?
4. How do these approaches relate to the methods you are familiar with in science class?
5. Where do you see potential for integrating inquiry-based methods in Open Schooling collaborations?

Description of Activity 6.2 (45 minutes)

The table below presents a model for adjusting the autonomy in the individual inquiry steps for the learners in order to adapt the activity to the pupil's level of skills, knowledge and competencies. It gives the opportunity to focus on a specific step of the process. The Danish National Science Learning Centre Astra has developed this guide for varying degrees of freedom in the work process. The table below is constructed with inspiration from their models. Compared to the first activity, the example of closed inquiry has been removed, since it does not represent a real participative inquiry-based learning approach.

Process Step	Teacher Structured	Teacher Guided	Open (pupil decide)
Scientific question *What, why or how? What is scientific about the question?*	The teacher asks the question	The teacher asks five questions from which the student chooses	The student asks the scientific question
Hypothesis *What do we expect? A proposed explanation of the science question. A hypothesis is never a question.*	The teacher poses the hypothesis of hypotheses set by the teacher or	The student chooses from a number the class.	The student puts forward his own hypothesis
Design *What method to use, where to set up, what materials to use, which variables are the central ones, which are constants and in what order to perform the elements of the method.*	The student is told what materials, equipment and set-up to use	The student chooses materials, equipment and set-up from a selection found by the teacher.	The student chooses the set-up and provides the equipment and materials
Investigate *Collect data, observe change and development, dissect and disassemble, measure physical change and manage all data.*	The student is given guidelines for the search	The student is given instructions by the teacher on how to collect data, or the student chooses one or more parameters of the survey to change	The student designs the study and collects data independently
Analyse *Analyse data and results, systematise data and results and interpret and compare them*	The student receives data and analysis results from the teacher	The student is given data by the teacher to be analysed or the student is shown how to analyse the data	The student analyses data independently
Conclude *Suggest answers and pick up on results. Conclude on connection between scientific question and hypothesis and results. Confirm or reject the hypothesis*	The student gets the explanation of results from the teacher	The student is given possible ways to link results and explanations, or is given process for linking	The student formulates independently explanations based on results

FIGURE 37. AUTONOMY IN SCIENCE INQUIRY TEMPLATE - SMALL

Step by step:

- Work in groups of 2-3 persons
- Find inspiration from a hen egg, for example:
    - Nutrients and health
    - Life cycle
    - Gastronomy
    - Evolution
    - Food production
- Decide a specific target group of learners
- Brainstorm on interesting questions to feed into an inquiry where an egg is included.
- Go through the steps of the inquiry process from Metode-Lab and facilitate a quick outline for a whole process in the template below - A Timekeeper gives 5 minutes per step and 1 minute warning.
- In each step the group must consider and decide on one autonomy level and write down ideas for what happens in this phase
- When the process is done, the group teams up with a neighbouring group and makes a brief mutual presentation
    - Discuss how the learning plan will work in action, when you alternate the autonomy in the different steps through the activity. Where are the strengths and weaknesses?

TABLE 4. AUTONOMY TABLE OF SCIENCE INQUIRY

Process Steps	Teacher Structured	Teacher Guided	Open (pupil decide)
Scientific question *What, why or how? What is scientific about the question?*	The teacher asks the question	The teacher asks five questions from which the student chooses	The student asks the scientific question
Hypothesis *What do we expect? A proposed explanation of the science question. A hypothesis is never a question.*	The teacher poses the hypothesis of hypotheses set by the teacher.	The student chooses from a number the class.	The student puts forward his own hypothesis
Design *What method to use, where to set up, what materials to use, which variables are the central ones, which are constants and in what order to perform the elements of the method.*	The student is told what materials, equipment and set-up to use	The student chooses materials, equipment and set-up from a selection found by the teacher	The student chooses the set-up and provides the equipment and materials
Investigate *Collect data, observe change and development, dissect and disassemble, measure physical change and manage all data.*	The student is given guidelines for the search	The student is given instructions by the teacher on how to collect data, or the student chooses one or more parameters of the survey to change	The student designs the study and collects data independently
Analyse *Analyse data and results, systematise data and results and interpret and compare them*	The student receives data and analysis results from the teacher	The student is given data by the teacher to be analysed or the student is shown how to analyse the data	The student analyses data independently
Conclude *Suggest answers and pick up on results. Conclude on connection between scientific question and hypothesis and results. Confirm or reject the hypothesis*	The student gets the explanation of results from the teacher	The student is given possible ways to link results and explanations, or is given process for linking	The student formulates independently explanations based on results

TABLE 5. AUTONOMY IN SCIENCE INQUIRY – TEMPLATE.

Process Steps - template	Teacher Structured	Teacher Guided	Open (pupil decide)
Scientific question *What, why or how? What is scientific about the question?*			
Hypothesis *What do we expect? A proposed explanation of the science question. A hypothesis is never a question.*			
Design *What method to use, where to set up, what materials to use, which variables are the central ones, which are constants and in what order to perform the elements of the method.*			
Investigate *Collect data, observe change and development, dissect and disassemble, measure physical change and manage all data.*			
Analyse *Analyse data and results, systematise data and results and interpret and compare them*			
Conclude *Suggest answers and pick up on results. Conclude on connection between scientific question and hypothesis and results. Confirm or reject the hypothesis*			

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Stærke nationale læringsfællesskaber (www.SNLiskyen.dk) - activity on autonomy in inquiry-based science education

Website:
https://testoteket.dk/hvad-er-en-undersogelse/frihedsgrader/

www.snliskyen.dk

Create your evaluation template

Training activity 7 (60-120 minutes)

Introduction

How did it actually go? This question ought to be asked whenever you sit around the table for the first time, to make the plans. Not because you are able to answer this question, but because you need to find out how to ask this question the right question.

Evaluation and assessment for Open Schooling activities serves several purposes. The core element here is the learning process and outcomes for the target group. There is also the evaluation of the collaboration process, hereunder the development of innovative content and methods, communication, sustainability and economy.

Purpose

This activity is supposed to inspire us to reflect on what kind of evaluation will create the best support for the concrete Open Schooling collaboration.

Since it is not necessarily to work with formative evaluation and assessment, there is room for having both summative and formative approaches at the same time. The purpose for the activity is definitely to train the formulation of formative evaluation aims and goals and this loop back to the activity from the 4C compass. The soft skills are difficult to evaluate in a summative framework, hence the introduction of the process oriented and forward looking formative approach.

Aims and goals

- The collaboration partners will attain a common language and understanding for how the Open Schooling project can be evaluated
- The work on the evaluation template will have influence on the planning of the actual collaboration planning
- There will be formulated formative as well as summative evaluation aims and goals for the collaboration
- Open Schooling innovation methods will influence the way the evaluation template is designed

Success criteria

- There will be an almost finished evaluation template for the Open Schooling collaboration when the activity is done
- The partners are aware of their own and each other's role and time plan in this evaluation template
- The evaluation template is designed in a way so that it supports further development and maybe strategic purposes for external documentation of achievements and learning points.

Description

Activity: Make a template for your evaluation plan.

Think about the OS project you are planning:

- Which outcomes you want to achieve –
- WHAT exactly should be evaluated during the formative resp. summative evaluation?
- WHO should be involved in the evaluation?
- HOW can you measure your outcomes?
- WHEN should you measure them?
- To WHOM you should report the results and when?

Remember that you can make as many evaluation criteria as you want to, and pick out the most relevant.

TABLE 6. EVALUATION TABLE TEMPLATE

Formative	**Describe how and when you will evaluate during the process**
What?	
Who?	
How?	
When?	
Reporting: to whom and when?	
Summative	**Describe how and when you will evaluate once the process is completed.**
What?	
Who?	
How?	
When?	
Reporting: to whom and when?	

ZonMW- adapted

Materials

- Markers
- Several templates, since there can be only formative and summative one goal or criteria per page

Signs of learning

Participants

- are discussing the concrete possibilities for evaluation
- are actively differing between summative and formative evaluation
- are defining concrete evaluation criteria
- select from both summative and especially formative suggestions for the final evaluation template

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