



# The Magic Factory:

(Den Magiske Fabrikken)

A centre for sustainability, innovative teaching and  
transformative learning

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**Resymé:**

This pre-project is preparing the foundations for a teaching model for optimal learning, motivations and participation for pro-environmental behavior. This model are to be further developed and implemented at Knowledge and experience centre *The Magic Factory*, which is a real-life example of a circular economy.



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# Preface and acknowledgements

This pre-project has the goal of preparing the foundation for an innovative educational model to be implemented at the knowledge and experience centre known as The Magic Factory. This centre is illustrating a real-life circular economy, and will be a place where kindergarden and schools can use areas for learning outside the classroom. The learning activities at The Magic Factory will aim at strengthening environmental knowledge and the holistic understanding, as well as motivate changes towards pro-environmental behavior.

The project has achieved support from the Regional Research Funds, Oslofjordfondet, and we appreciate that they found the project worth supporting. The project group has consisted of Vesar as project owner, Telemark Research institute (TRI) as a research partner and project leader and the University College of Southeast Norway (HSN) as a project partner.

We also wish to thank all the welcoming people we have met face-to-face on study trips, as well as those sharing their experience with us over the telephone. Your information has helped us to acquire an overview and insight in ongoing activities and efforts regarding teaching for sustainable development.

Bø in Telemark, Norway, 1st of November 2016

Christine Hvitsand, Telemark Research Institute / Telemarksforsking

Project Leader

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# Summary

The knowledge and experience centre, The Magic Factory, addresses how to inspire and motivate people to changes in behavior to favour the environment. The main objective of the pre-project has therefore been to develop an innovative educational model, suitable for strengthening knowledge and motivation in order to increase recycling, reduce climate gas emissions and enhance sustainable food production in the region. The second stage of developing the centre, in a continuation of this project, will be to implement the teaching methods at the centre. The main target visitor groups are children and employees in the educational sector: kindergardens, schools and higher education.

The inter-municipal waste company Vesar has ambitious goals regarding recycling rates, which are mutually supportive of national and regional political goals regarding climate gas reduction, sustainability and a circular economy. The Magic Factory is illuminating a unique concept of a circular economy with renewable energy and recycling of waste, as well as food production and consumption – all bounded together. Much of the infrastructural and political arrangements for recycling are in place, but there is a need to enhance the broader society to apply to environmental behavior. There is an interplay between technologies, infrastructure, regulations and other external factors, and the way a person understands, interprets and acts in relation to this, c.f. Elzen et al. (2004). In order to achieve the necessary sustainability transitions, there is a need to focus on the personal spheres, c.f. Sharma (2007) and O'Brian and Sygna (2013). Awareness raising, participation, increased knowledge and understanding are all important factors in order to motivate for changes in one's own behavior and consumption patterns.

The pre-project has utilized a diversity of methods for data collection in order to achieve a broad insight into pedagogical approaches in use, and to identify important factors for “transformative” learning, e.g. literature, interviewing representatives for existing teaching schemes, study trips in Norway, England and Denmark, and arranging workshops with kindergardens and schools in the region. All these sources emphasize the importance of meeting educational targets in the curricula by using out-of-the-classroom learning areas, c.f. DuPuis and Ball (2013) regarding the need for educational models that go beyond traditional teaching. Together with different theoretical teaching approaches, such as didactic relational thinking, we have been able to frame what we call a “magical learning theory”, which is elaborated on in this report.

# Sammendrag

I Vestfold-regionen har det blitt utviklet et unikt konsept for sirkulær økonomi, hvor fornybare energikilder, gjenvinning av avfallsressurser og matproduksjon står i sentrum. En sentral del i dette systemet er biogassanlegget på Rygg i Tønsberg, som har fått status som nasjonal pilot, og er banebrytende både med tanke på samarbeidskonstellasjoner og teknologi. Gjennom kunnskaps- og opplevelsessenteret Den Magiske Fabrikken ønsker det interkommunale avfallsselskapet Vesar å benytte hele sitt fysiske område som en læringsarena helt i front når det gjelder innovative og «transformative» pedagogiske læringsmetoder for økt miljøbevissthet og endret miljøatferd. Målgruppen for senteret – i alle fall i første omgang – er barnehager og skoler på alle nivåer, herunder høyere utdanning slik som lærerutdanningen. Senteret vil være relevant for alle fag i skolen og bidra til å oppfylle målene i læreplanene. Formålet med senteret er å øke kunnskap, handlingskompetanse og motivasjon for mer miljøvennlige handlinger, slik som å redusere avfallsmengdene og å kildesortere mer. Vesar har et ambisiøst gjenvinningsmål på 70 prosent innen 2020, men omfattende innsamlingsordninger er ikke tilstrekkelig for å nå dette målet. For å stimulere til endret adferd hos den enkelte, og til bærekraftsomstillinger og et grønt skifte, er det nødvendig å se teknologi, infrastruktur og andre betingelser i sammenheng med hvordan folk forstår, tolker og handler, noe som blant annet har sammenheng med kunnskapsnivå og verdigrunnlag (jf. Elzen et al. (2004), Sharma (2007) og O'Brian og Sygna (2013)).

Dette forprosjektet, med finansieringsbidrag fra Oslofjordfondet, har identifisert viktige faktorer for en læringsmodell med fokus på opplevelser og helhetlige læringsformer som inkluderer kroppen, sansene, erfaringer og sosialt ansvar, og å utvikle en slik læringsmodell. Prosjektet har vært et samarbeid mellom Vesar (prosjekteier), Telemarksforskning (prosjektleder) og Høgskolen i Sørøst-Norge.

Det har blitt benyttet et mangfold av metoder for datainnsamling for å få en bred innsikt i ulike pedagogiske tilnærminger og for å identifisere viktige faktorer for transformativ læring: gjennomgang av litteratur, intervju av representanter for eksisterende undervisningsopplegg for bærekraftig utvikling, studiereiser i Norge, England og Danmark, og fasilitering av workshops med barnehager og skoler i regionen. Alle disse kildene understreker betydningen av å møte de pedagogiske målene i læreplanene ved hjelp av andre læringsarenaer enn klasserommet jf. Dupuis og Ball (2013). Sammen med ulike teoretiske læremetoder, som for eksempel didaktisk relasjonstenkning, har vi vært i stand til å ramme det vi kaller en "magisk læringsteori", som er utdypet i denne rapporten.



# 1. Introduction

The circular economy is gaining increased attention in Europe as a necessary trajectory in a constricted world with emissions of climate gases, resource scarcity and loss of biodiversity. This situation is elaborating the need for sustainability transitions on production and consumption, and innovative approaches on how we organize society in order to inspire households, businesses and the public sector to reduce climate gas emissions and to use resources more efficiently.

In a White paper, the production of biogas based on household food waste and manure is identified as an important measure in order to reduce climate gases and recycle plant nutrients (Meld. St. 21 (2011–2012) *Norwegian Climate Policy*). Furthermore, the national waste strategy points out that reduction of waste, reuse and recycling of materials are to be prioritized, as this will provide environmental benefits (Ministry of Climate and Environment, 2013).

The knowledge and experience centre, *The Magic Factory*, which this project is about, addresses how to inspire and motivate people towards the changes necessary to meet these challenges. This project is about how to make the visit and communication into a participatory and magical experience, enhancing changes in attitudes and behaviors in favor of the environment. This outlines being done in close collaboration with kindergardens, schools and the teacher education, acknowledging learning about and understanding sustainability to be important factors regarding the green shift and sustainability transitions.

## 1.1 The circular economy around Vesar

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The inter-municipal waste management company Vesar, in Vestfold, Tønsberg, is the initiator and base for a unique concept of circular economy. The circularity is based on renewable energy, recycling of waste and food production and consumption – all bounded together. At the heart of *The Magic Factory* (as it is called) is a biogas plant recycling organic waste and manure from surrounding farms. This plant is producing biogas used as fuel in both waste collecting vehicles and in buses, in addition to bringing forth recycled bio fertilizer to the farms and to a greenhouse under establishment. The biogas plant has the status of being a national pilot, and the greenhouse is also applied for being a pilot regarding new isolation techniques and energy management, combined with educational purposes. The close collaboration between different stakeholders in the community are essential for the realization of the ideas, some of these constellations are unconventional – like the (public) waste sector and the (private) agricultural/food sector (Hvitsand & Kleppe, 2011). The circular economy is illustrated in Figure 1.



Figure 1 The circular economy regarding organic waste (source: Vesar)

The households in Vesar's 12 municipalities collect a wide range of waste: paper/cartons, plastics, bio, glass/metal, textiles and hazardous/EE waste. Additionally, there are recycling points where households and businesses can deliver different waste fractions. Today, the recycling rate for households in Vestfold is 53%, although Vesar has a target of 70% within 2020. To be able to establish such innovative circular solutions and reach the goal, there was a need for Vesar to anchor the idea of a circular system at the policy level and in the strategies of the owner municipalities. It is also integrated into the climate strategies and planning at the county council level, and for collaborative partners in the biogas cluster in the Oslofjord region.

As seen, the infrastructural and political arrangements for recycling are in place, but in order to increase the recycling rate it is considered important to encouraging knowledge building and inspiration towards pro-environmental behavior in the broader society. To help frame these efforts and approaches, the knowledge and experience centre is being established, and is going to implement interactive and innovative educational approaches. This project is about the development of such approaches that will raise competencies for pro-environmental behavior. At this first stage the main target groups are children and employees in the educational sector; kinder gardens, schools and higher education, in addition to families in general. The centre will give the opportunity for a site-specific learning facility outside the classroom, where the physical elements and architecture will be important contributors for the experience.

## 1.2 About the project

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### 1.2.1 Development of The Magic Factory as a centre

This pre-project (qualification project) is supported by the Regional Research Funds, Oslofjordfondet. The project is about the approach and content of The Magic Factory as a centre for learning and experience, outlining frames of innovative pedagogical methods of communication, education and participation to be employed for ambitious results regarding pro-environmental behavior. In the next phase, this will generate targeted activities toward the public generally, and children specifically, in order to raise awareness about the global environmental challenges and sustainability, and to stimulate positive changes in environmental behaviors.

### 1.2.2 Objectives

The main objective of the project is:

*Developing an innovative educational model to strengthen knowledge and motivation in order to increase recycling, reduce greenhouse gas emissions and enhance sustainable food production in the region. These methods are to be applied at the knowledge and experience centre, The Magic Factory.*

Sub-objectives are to:

O1: Further develop existing knowledge of teaching methods for optimal learning and implementing interdisciplinarity in the approach towards changed environmental behavior;

O2: Make sure activities at The Magic Factory meet educational targets in the curricula by developing strategies to generate interest in- and involvement from the educational sector, as well as how the cooperation can take place;

O3: Prepare the foundations for a model for optimal learning, motivation and participation that contribute to long-term behavioral change, which also has a transfer value to other regions and themes;

O4: Prepare how a collaboration between the centre and the study, "Master of pedagogical resources", can contribute to mutual learning and practical utilization; and

O5: Create an idea bank with new innovative activities, target groups and other relevant cooperation actors.

From these objectives, we can draw the questions for these pre-project: What characterizes a pedagogical model enhancing sustainability and transformative learning? Thus, this project is limited to define the frames of such teaching methods, as well as establishing collaboration with the educational sector. The further development, testing and evaluation of such pedagogical methods are to be studied in continuation of this pre-projects.



### 1.2.3 Methods of data collection

The pre-project has utilized a diversity of methods of data collection in order to achieve a broad insight into pedagogical approaches in use, and to identify important factors in the further development of such methods and models. Both in Norway, England and Denmark this includes both those regarded as major national actors in teaching children and youth about sustainability, as well as actors selected more randomly based on word-to-mouth information and internet search.

The following is a list of activities and how the project group has collected data:

- Literature on circular economy and sustainability transitions regarding the “role” of values, attitudes, preferences, motivations and behavior;
- Literature regarding teaching for sustainability;
- Interviewing Norwegian actors with experience in education for sustainable development:
  - o Den Naturlige Skolesekken (The Sustainable Backpack) and Naturfagsenteret (The Norwegian Centre for Science Education)
  - o LOOP Miljøskole (LOOP Environmental school)
  - o Avfall Norge (Norwegian Waste Management and Recycling Association)
  - o Returkraft in Kristiansand
  - o Geitmyra matkultursenter for barn (Geitmyra Culinary Centre for Children)
  - o The blog group Grønne jenter (Green girls)
- Study trips to targeted places/facilities:
  - o England (the whole project group participated):
    - The Sustainability Centre in Petersfield
    - Carymoor Environmental Centre in Somerset
    - The Eden Project in Cornwall
  - o Denmark:
    - WasteLab / Vestforbrænding in Copenhagen
    - Amager Resource Centre in Copenhagen
- Workshop with kindergardens and teachers at elementary schools and high schools regarding how to cooperate according to the curriculum and discovering their needs.

The entire project group participated in the study trip to England and at the workshop. The achieved knowledge and experience from the different sources of data collection and activities are presented in Chapters 2-5. In Chapter 6, the findings are synthesized and analysed in order to frame what we consider the most important factors in a transformative learning model, and to outline a *Magic Learning Theory* to be further developed and implemented at The Magic Factory.

## 2. Sustainability transitions toward the circular economy

Elzen et al. (2004) promote the need for fundamental changes in how our societies function. The societies of today face structural problems in several sectors that arise from our production and consumption patterns. To reach substantial improvements in environmental efficiency, there is essential to go through system innovations to create new systems. By this, we understand that transitions toward sustainability means stepping out of today's *socio-technical systems* and into another system structurally different. These involve new technologies and an understanding of how the technology interacts with other elements in society, such as regulations, infrastructures and user contexts and meaning (like competencies, preferences, cultural values, interpretations and practices). This view takes into account that innovations in technology from the supply side also have a user side, and that "the market" is not neutral and just adopts new technology. In line with this, sustainability transformations in societies are multi-actor processes taking place across levels and sectors. With reference to Sharma (2007), O'Brien and Sygna (2013) present three interacting spheres of transformation: the practical, political and personal spheres, which can be used as a tool for "how, why and where transformations towards sustainability may take place" (p. 1). Taken together, these perspectives are framing how to understand, encourage, analyse and learn from sustainability transformations in societies, and can therefore be useful for our project.

The European Environmental Agency is outlining key characteristics and technical, economic and socially enabling factors required for transitions toward *circular economies* (European Environmental Agency, 2016). Enabling factors relevant for the focus of this pre-project include stakeholder interaction, participation, awareness raising about changing lifestyles and consumption patterns, increased knowledge and skills through the exchange of knowledge and education. Such factors are important in order to secure the support and use of practical structures, such as recycling arrangements and facilities.

According to a British study, barriers for recycling are related to infrastructure, such as the number of waste fractions being able to be sorted from the residual waste, the size of containers, the space to store containers and the frequency of collections (Pocock et al., 2008). Furthermore, knowledge and understanding, as well as attitudes and motivations, are factors having an impact on recycling behavior. However, even though services are provided for people to recycle, not everyone is participating. (Thomas & Sharp, 2013) find that identity, values and social norms are decisive regarding recycling behavior. This can make it difficult to use normative messages to non-recyclers about recycling, since that might be perceived as a threat to their identity. Moreover, the authors have a notable concern that recycling behavior might limit some individuals from other pro-environmental behavior, such as waste reduction. As long as they do not sufficiently hold environmental values, recycling might be considered to be "their part" of environmental contribution. In comparison to this, a study finds that Norwegian (already conscious) consumers engaging in local food systems enforces their values and motivations toward other pro-environmental behaviors and collaborations through participation and learning (Hvitsand, 2016). Another Norwegian study shows that dissemination of environmental benefits through "creative messages, formats and channels", in addition to concrete examples, are motivating environmental behavior (Kilsti & Aabech, 2011).

Climate psychologists like Per Espen Stoknes (2015) are addressing difficulties in the communication of climate change when it comes to engaging for action. Despite the certainty of the human-created global warming, and the communication about the negative effects, the current fact-based communication is not inspiring people to act. Stoknes argues that more facts on climate change are not triggering behavioral changes, as it is rather a need to understand how people get engaged within social contexts. It

needs to be simple, social and fun doing pro-environmental choices. The communication also needs to be within a positive atmosphere focusing on opportunities for businesses, economic savings and increased quality of life, instead of on the disastrous aspects.

Nonetheless, changing people's behavior does not necessarily require the individuals to hold environmental values and knowledge according to the behavioral economic approach. Through thoughtful planning regarding the situations in which individuals make decisions, people can be *nudged* to make the "best" choice regardless of their own values. Thaler and Sunstein (2008) explain nudging as "any aspect of choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (p. 6). Nudging can be: a) a product or service placement and presentation, b) making the "best" choice to be the default option and thus the easiest choice, and c) the use of social context and norms. However, to what degree nudging leads to changes in environmental values and general pro-environmental behavior is questionable. Stoknes (2015) explains that negative environmental behavior (as a result of living our lives in today's society rather than in a place away from everything) leads to negative environmental attitudes, as we get used to- and adjust to how we live our lives with the unsustainable production and consumption of today.

To get a shift in society towards new worldviews, insights in challenges and participation in creatively identifying solutions, it is necessary to implement innovative methods to engage the society that the emerging centre at Vesar addresses. This is of special importance, as the technical and infrastructural solutions originate in top-down initiated innovations based on environmental goals, so thus there is a need to engage the public. This is in line with Morone et al. (2015) in regard to the necessity to get "pressure" from several sources, channels and levels in the socio-technical regime in order to achieve changes in behaviors. Technology and infrastructures for recycling play important roles in the sustainability transformations in our case, but there is also a need to explore how to make the societal transformations through environmental knowledge building, awareness raising and changes in everyday environmental behavior. The possible pitfalls of recycling as a limitation to other environmental behaviors, such as waste reduction, c.f. Thomas and Sharp (2013), are important to be aware of when designing the messages of The Magic Factory.

# 3. Pedagogical methods

## 3.1 Education for a sustainable future

A growing awareness about ecological crises and climate changes has motivated different forms of action among teacher education institutions around the world. Many governments, organizations and institutions work on promoting the importance of sustainability in teaching and learning, both as part of the formal education and outside schools. As an example of this focus, The Association for the Advancement of Sustainability in Higher Education (AASHE) has developed a system for tracking, assessment and rating among universities in order to measure their sustainability performance. The interest for teaching for sustainability is probably also motivated by diverse initiatives driven by the United Nations. This is not surprising, knowing that the UN called on universities around the world to engage in making education for sustainability a central focus during “The UN Decade of Education for Sustainable Development” from 2005 – 2014. The figure below shows the “Sustainable Development Goals” being established:



Figure 2 UN Sustainable Development Goals (source: United Nations website)

As the figure shows, there is an entire set of different goals, all of which are relevant regarding the teaching of the environmental, economic, social and cultural sustainability that The Magic Factory is undertaking. This is in harmony with the concept of “broad values creation”, in which sustainability is regarded as an integrated phenomenon, where all forms of sustainability, as with all forms of social, cultural, economic and ecological value creation, strengthen each other (Haukeland, 2010; Haukeland & Brandtzæg, 2009). This means that you cannot fully promote ecological sustainability without also addressing issues of social, cultural and economic values in a larger community context.

We know today that working towards a sustainable future requires educational models that go beyond traditional teaching (DuPuis & Ball, 2013). Learning and teaching for sustainability require pedagogical approaches that do not deal with present authoritarian forms of passing information, but with interdisciplinary, collaborative, participatory forms of learning in communities of practice. Such socio-constructive pedagogies can allow each learner to negotiate their own understanding – finding meaning in interactions within their social and environmental environments (Fredriksen, 2011; 2012; 2013).

Pedagogical approaches that build on students' active engagement and holistic experiences, as promoted by John Dewey (1916, 1925, 1930, 2005 [1934], 2007 [1938]) among many others, have capacity for personal transformations (DuPuis & Ball, 2013). Also the place, with its architecture and design, is regarded as "The Third Teacher" because of its importance on how children learn (Bruce Mau Design, 2010).

## 3.2 Theories and approaches for sustainability in education

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In this section, we will look at some theories and models that are relevant to the model for a Magical learning model at The Magic Factory.

### 3.2.1 Background

A book by Astrid Sinnes (2015) gives us a good framework to talk about how what we will call "the magical learning theory" of The Magic Factory enters the discussion. It also addresses various methods relevant for what will take place in the learning centre being established. Sinnes starts out by asking that any education for sustainable development needs to be clear on the what, the why and how of what it is that students need to know and learn in order to live sustainably in the future. She refers to a study of school leaders in Norway in 2011, which found that only 9% of school leaders found the UN decade for teaching sustainability to be an inspiration for the teaching in their school. Schools are therefore important to implement the necessary changes for a sustainable future.

Part of the research into education for sustainability is what to teach. Sinnes outlines four elements of an education for sustainable development (2015, p. 37):

- Updated knowledge about climate and sustainability;
- Cross-disciplinary approaches to teaching sustainability;
- Develop competencies other than the theoretical, such as creativity, critical thinking, future thinking and future hope, action competence, and to enjoy less consumption; and
- Schools should be an arena to learn how to live more sustainably.

As we saw above, the focus here may be a bit too strong on knowledge as theoretical knowledge and outcome in form of competences, and not so much on values, attitudes and the grounds for making wiser decisions. Still, the grounds of hope and the grounds for joy of less consumption require such a broad approach. Sinnes is inspired in part by John Dewey's Inquiry-based teaching, as Dewey is not only speaking of the how and the what when it comes to learning by doing, but also the why. What is it that drives the learning process? What are its values and its vision?

Sinnes reformulate Dewey's learning process as follows: 1) post a question/problem, 2) gather data and assess different answers, and 3) build knowledge that is relevant (p. 122). In this, we find that all steps in the process require a purposive touch to it: what is problematic, for whom and why; how are we to assess without asking the grounds and values for assessment, and what is relevant knowledge for whom and why? Dewey inspired the Project Method (Kilpatrick, 1918), which to a large degree is a purposive-driven method. Similarly, we need to bring in the purpose of education linked to other methods, such as the Biological Sciences Curriculum Study (BSCS) that Sinnes discusses. It builds on a 5-step instructional model: 1) engage, 2) explore, 3) explain, 4) elaborate, and 5) evaluate. This model is linked to the values of the curriculum by purpose/aim, activities and outcomes.

Sinnes argues for three ways of teaching approaches for sustainability: phenomenology-based teaching, collaborative learning and using the outdoors as classroom. These are explained in the following, in addition to the didactic relational thinking.

### 3.2.2 Phenomenology-based teaching

Through the phenomenology of teaching, students are trained to experience the world, and not only in theory (in Sinnes: Østergaard & Strangstadstuen, 2004; Østergaard, Dahlin & Hugo, 2008). They are able to observe, touch and feel the different phenomena of the world before learning them theoretically. According to Sinnes, the basic principles are the following (2015, p. 122):

- Start with reality. The phenomenon is actual, learn about leaves turning yellow before one learns about karotenoider and xantofyll.
- Start with students' lived experience: Students gain inspiration, motivation and ownership to learning through experience.
- Phenomenology is doing things. They should be able to feel, smell, touch and experience the changes in their own lives or in a laboratory.
- Students' relation to the world is diverse. We see things differently: Let students acquire access to the phenomenon in their own way so that they obtain ownership of it.

Sinnes suggests that the carbon cycle could be a good phenomenon based on teaching, which is a topic closely in line with the idea at The Magic Factory.

### 3.2.3 Collaborative learning

This is a pedagogical approach using small groups of students as a tool to learn various topics (in Sinnes: Johnson, Johnson, Haugaløkken, & Aakervik, 2006). What is important to collaborative learning are certain structures that can be exemplified with the following:

- Work through problems together, e.g. through certain games where all students contribute in a sequence. One writes a problem on a sheet of paper and sends it around to each student for their contributions, which in the end creates one collaborative effort in solving the problem.
- Work with playful games. For example, climate bingo after a lesson to summarize and check-out what the students have remembered from the day at The Magic Factory. The teacher can make a list of several questions such as: "Who knows on average how much trash a Norwegian throws away each year?" The students search for fellow students who know the answer, and in such a manner try to fill out the entire page full of questions. It is a method for seeing how collective efforts give the most answers.

### 3.2.4 Using the outdoors as a classroom

The third aspect that Sinnes (2015) outlines – and with relevance for The Magic Factory – is using the outdoors as a classroom, c.f. Frøyland (2010) and Jordet (2010). Sinnes describes eight signs of outdoor learning:

- The school environment is used as a learning arena;
- The school environment is used as a source of knowledge;
- Collaborate with actors in the local community;
- Use a problem-solving inquiry approach to supplement theoretical teaching;
- Use creative, productive and play-based approaches to supplement cognitive teaching
- Learning through the use of body and senses to supplement sitting still;
- Learning through communication and social collaboration in the world, not teaching about the world but in the world; and
- Forming of the whole human being, head, heart and hand.

### 3.2.5 Didactic relational thinking

During the 1970s in Norway, there was an extensive project in schools called “Miljølæreprosjektet” (“Environmental learning project”) (1969-1977), which was led by the two pedagogues, Bjørndal and Lieberg. They were influenced by the ecophilosophical movement in Norway, among them the Norwegian philosopher Arne Næss. They applied the ecological and ecophilosophical way of thinking into the realm of education in their book *Økopedagogikk* (Bjørndal & Lieberg, 1975) (see also Haukeland, 2009). In this work, they developed a figure that was to illustrate for generations to come how one can think didactical and relational in schools. The five aspects are aims, content, presuppositions, activities and evaluations. We see it has a resemblance to the learning by doing approach to Dewey. This model was also in a later book by Bjørndal & Lieberg (1978, p. 135) presented as the following figure illustrates:

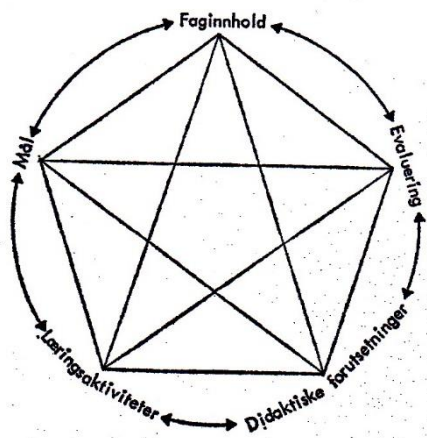


Figure 3 The didactic relational thinking model

The figure shows the relational interdependence between the various didactical categories. In particular, they enhanced three important principles related to the model:

1. It supposes a reflective relationship to teaching, learning and curriculum, which is grounded in values and philosophical perspectives.
2. One or another category has no precedence compared to the other categories, as they are all interdependent.
3. Educational planning should not lead to detailed instructions, with no room for subjectivity and improvisation.



### 3.3 Practical steps towards sustainable schools

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We have now presented some of the key theories and approaches regarding teaching for sustainability, which we will be using to develop a model for Magical Learning at The Magic Factory. In Chapter 6, we will get back to how these methods and models can be applied in The Magic Factory, but first we will look at practical steps toward sustainable schools.

Sinnes draws on Scott (2013) in this regard. Scott talks about the following five phases in the process of developing a sustainable school:

- 1) Phase 0: When teachers simply teach what is in the curriculum.
- 2) Phase 1: Individual teachers start projects here and there for sustainability.
- 3) Phase 2: School leaders recognize the importance of ESD.
- 4) Phase 3: A school has defined its goals for ESD.
- 5) Phase 4: A school is established as a sustainable school that actively works in school building and teaching for ESD.

Referring to Stone (2009), Sinnes draws together the following points that she finds important in developing an education for sustainability that will be related to The Magic Factory:

- Find people who share your interest in sustainable development in order to build initiatives.
- Have clear visions and aims for The Magic Factory.
- Know the challenges and possibilities in the nearby area.
- Plan and make a strategy, and start on the path from vision to action.
- Reflect, follow up and evaluate, and do not forget to celebrate the small steps.
- Start a new cycle with change projects and remember: Things take time.

The Magic Factory will be an example of those different phases and approximations to an education for sustainability that Sinnes outlines and seeks to promote. At the heart of The Magic Factory is close collaboration with schools, school leaders and teachers. As such, The Magic Factory will be a contributor to how to make schools become what Sinnes calls: “sustainable schools”. Furthermore, it seeks to not only create sustainable schools, but sustainable communities through inspiring pupils to work in their own households. Hence, The Magic Factory creates a bridge between schools, communities and households through the pupils and the circular economy that Vesar is an expression of.

# 4. Examples of institutions teaching for sustainable development

This chapter gives examples of institutions teaching sustainability in Norway, England and Denmark. In different ways, national programs, science centres and other initiatives all focus on teaching children and youths about environmental issues and sustainability. When formulating the pedagogical approach at The Magic Factory, it is useful and important to build upon these existing experiences.

## 4.1 Norway

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### 4.1.1 Den naturlige skolesekken (“The Sustainable Backpack”)

“The sustainable backpack” is a state-funded scheme with the purpose of raising awareness and an environmental commitment among children, youth and teachers. The applicable funds and supportive competence offered are to stimulate schools at all grades in organizing projects enhancing education for sustainable development. The environment and the educational authorities are together behind the scheme, which was established in 2009, and are operated from Naturfagsenteret (“The Norwegian Centre for Science Education”). Every year, there is a call for projects in primary school, secondary school and high school. External actors can also apply in order to carry through activities in schools.

Both the pupils and teachers are target groups when it comes to awareness raising and increased competence in sustainable development. Participating schools receive both funds and guidance, in addition to an increase in competence in order to develop teaching materials and conduct teaching for sustainable development. According to the project leader of The Sustainable Backpack, the schools are encouraged to apply for three years, as the first year is aimed at developing teachers’ competence and the teaching materials.

The Sustainable Backpack is founded on four perspectives:

- Explorative education;
- Inter-/multi-disciplinarity;
- Use of the local community (nærmiljøet in Norwegian) as a learning area; and
- Collaboration with actors outside the school

The project leader emphasizes the importance of ownership of projects by anchoring the application of a school project, both at the school leader level and in a multidisciplinary project group of teachers. It is necessary that the teachers achieve working hours specifically set to participate at the national gatherings (twice a year) and the regional gatherings (once a year), and to work in the multidisciplinary project group at the school. During and in-between these gatherings, they actively work with their teaching outline, as well as doing reflections around what they are doing. There is a strong focus on the teachers, in order for them to develop an understanding of education for sustainable development and to enhance didactic reflections. The Sustainable Backpack uses the 5E model in the teacher gatherings, which is elaborated on in Chapter 3.2.1 (there called the 5-step instructional model).

The Sustainable Backpack has readymade teaching programmes within different topics, which the schools can use as a base for their own project related to their own community. The projects must cover several school subjects, and the teachers must develop learning goals and outline how the pupils will be involved in the project. The project leader of The Sustainable Backpack explains that they are helping the schools to broaden their approach about how to work with a topic, such as waste, from different perspectives and with different activities in order to obtain a holistic picture. She explains that the general impression is that it is difficult for teachers to go from being an objective submitter of knowledge to conveying competencies of acting (“handlingskompetanse” in Norwegian), touching people’s values and way of living. However, this has developed in a positive direction over the past few years due to how the scheme’s teaching programmes have been formed.

The leader emphasizes that it takes time to develop competence and create change for sustainable development, and that this does not happen during one day, one week or one year. It is therefore important to follow up the pupils over a longer timeframe. A challenge to be aware of when it comes to visits is that it might be difficult to reach all the pupils when being a teacher from outside. To make it successful, you need to make sure that everybody is benefitting from the visit, and not only the most interested ones, even though you do not know all the individuals in the group. In this regard, it is important that the classes are doing work both ahead of- and after a visit. The leader illustrates the importance for the involvement of the classes’ teachers by explaining about a small visitor farm. Here, they have changed their approach towards the schools, and the teachers are now coming to the farm ahead of the visit, for preparation on how to use the visit in their own learning context.

#### 4.1.2 Naturfagsenteret (“The Norwegian Centre for Science Education”)

The Norwegian Centre for Science Education was established in order to be a national resource and contribute in the improvement of the science education. The centre has several projects, with one of them being the scheme of The Sustainable Backpack described above.

The leader at the centre explains that they always ask themselves the questions: What do we want to achieve, and what does it take to understand? The reason for asking those questions is that teaching must bring in reflections and thinking moves, thus promoting reflexive thinking in the classroom and new strategies of thinking processes. The leader emphasizes emotional awareness and bodily experience as important factors for learning. The teaching process should also bring up discussions about “What did I do just now” and “What did we find out”? The centre urges the evaluation of programmes, and to redesign and improve them using feedback from teachers and the children. They recommend new teaching arenas to provide interactive exhibits, as this enhances constructive processes and initiates reflection.

"Teaching for understanding" is a recipe that the centre refers to. It consists of different phases when they make new programmes. First, there is a generous phase focusing on brainstorming, then finding out what to measure, what they should learn and what kind of content the programme should have, as well as what kind of activities, exhibitions and lectures.

According to the leader, The Norwegian Centre for Science Education wants all their programmes and projects to lead to a high involvement and development of knowledge, and evaluated them through observing and measuring. They also urge all projects to be long-term.

### 4.1.3 LOOP Miljøskole (“LOOP Environmental School”)

LOOP is a foundation owned by the recycling companies for the different waste streams, funded in part by the Ministry of Climate and Environment. LOOP is a “knowledge resource” for the waste branch and for the general public. The foundation is running the website [www.sortere.no](http://www.sortere.no) with information about recycling arrangements around the country, and [loopedia.no](http://loopedia.no), an encyclopedia about recycling. Furthermore, LOOP is targeting children and youth toward a better resource understanding by reaching kindergardens and schools through LOOP Miljøskole (“LOOP Environmental School”). Fifty-eight municipalities and inter-municipal waste companies are “subscribers” of the environmental school, and are therefore contributing to financing the LOOP Environmental School – making the material and other resources free of charge for the schools.

The LOOP Environmental School prepares teaching materials throughout the educational course, adjusting it to the curriculum, within most subjects and also interdisciplinary. Booklets, cartoons, music, movies, theatre and a set of pre-prepared tasks for classes are all available teaching resources. Tasks range from measuring the amount of waste at home or in the classroom, investigating and learning about different packaging, interviewing grocery managers about waste production and recycling, creating stories, “forskerspiren” and much more. They use well-known Norwegian characters for children, such as Knutsen and Ludvigsen, and the Swede Albert Åberg. Several of the municipalities and inter-municipal waste companies are using the material to educate the younger generation, usually in combination with visits to waste handling facilities. Often, the fourth-graders do visits, as the curriculum for that grade has specific learning targets related to recycling.

The project leader of the LOOP Environmental School is educated as a teacher, and the leader’s task is to ensure that the teaching materials are safeguarding competence targets in the curriculum. LOOP is helping to facilitate the teaching, but are not teaching schools themselves. There is written guidance for teachers, and LOOP helps the municipality or inter-municipal waste company to prepare for visits from schools. The leader explains that the schools appreciate that they offer ready-made programmes which they can implement directly, thereby reducing their need to prepare anything themselves. For example, the digital teaching tool called [avfallspyramiden.no](http://avfallspyramiden.no) (“The Waste Hierarchy”) is well acknowledged.

However, there are big variations when it comes to the extent the waste handlers are focusing outwards to society, and how they carry out their school visits. The schools sometimes get booklets in advance from the waste company to prepare, but usually not. Moreover, the leaders are not sure whether children are encountering the material from the LOOP Environmental School several times during their course of education, but they know that many schools are using the material in several grades.

Every year they arrange “The LOOP days”, in which all educational personnel at the waste handling facilities are gathered together for a two-day workshop discovering needs, exchanging knowledge and ideas. In order to ensure the quality, they use teams of teachers to discuss new activities and approaches, often in focus groups.

### 4.1.4 Returkraft

According to Avfall Norge (“Norwegian Waste Management and Recycling Association”), there are not many of the municipal or inter-municipal waste companies that have teaching programmes that go beyond general tours around the waste handling facility. However, a few of their members are reaching out to schools with pedagogic approaches going beyond such modest visits and what is facilitated by LOOP Environmental Schools, e.g. Oslo Ren and ROAF. Here, we are presenting one inter-municipal company, Returkraft.

“Returkraft” in Kristiansand is an energy recovery company owned by six inter-municipal waste companies that handle residual waste after the source separation of several waste fractions. They are inviting kindergardens, elementary schools and high schools (including vocational studies), as well as students and other groups. This adds up to approximately 2,000-3,000 visitors a year. In addition to the plant itself, there are visitor rooms furnished and decorated creatively using waste installations and accessories. These rooms are used for an introduction to the visit, open thinking and discussions, and there is also a teaching programme that uses five-six stations. The stations have screens, and different energy and waste-related topics, consisting of, e.g. math tasks and quizzes. In addition, it is possible for the visitors to participate in firing a steam engine, doing “a real unfair relay”, treasure hunting and more – with these activities aiming at involvement and making it an experience.

The activities and teaching are related to the curriculum, both when it comes to sustainable development and the different subjects (mainly math and natural sciences, but also other subjects). In order to prepare for a visit, the pedagogue at the company communicates with the teachers about the focus of the visit, and the programme is adjusted for age and the topic of interest. A film about the facility is available on their website, and the teachers are encouraged to show it in the classroom before arriving. The pedagogue at Returkraft is leading the programme, and the school teachers have the role of keeping the group together.

Returkraft is cooperating with University of Agder and schools in a project called “MathEUS”, which is led by Naturfagsenteret (“The Norwegian Centre for Science Education”). The project started in relation to the national initiative “Lektor2”, and targets increased learning outcomes in mathematics. This is being done by developing teaching programmes/materials attached to realistic mathematic questions in the workplace, in order to visualize the practical application of the subject.

#### 4.1.5 Geitmyra Culinary Centre for Children

Geitmyra is a non-profit foundation that rents a farm from the Oslo municipality, and achieves financial support from different contributions and sponsors. Geitmyra has a small vegetable garden and runs educational programmes for children. The main agenda of the foundation is to make children fond of healthy food, and the vision is to ensure that as many young people as possible learn to enjoy food that makes them well. This includes contributing to kids and adults in making conscious choices when it comes to food.

Geitmyra receive school visits daily, reaching out to broad-based groups of children and youth. Teaching materials and experiences are shared online to get a national distribution to whoever wants to use the materials. During the visits, the children prepare food using fresh ingredients, primarily organic, and use thoroughly tested recipes. Even so, the most important part of the learning is the children's own participation in cooking. The recipes and educational programmes are based on recommendations from the Health Directorate on what to eat.

Approximately 2,500 primary school children visit the centre each year. Groups are given instructions and educations from staff teachers, who are experienced restaurant chefs. The staff takes the teaching of the kids seriously, meaning they expect as much from them as they would from adults in their cooking courses, and provide the same quality of education as they would give adults.

Themes and teaching follow the seasonal variety of the year, with indoor activities in winter, outdoor teaching in spring, summer and autumn. Examples of activities are cheese making, harvesting, gutting fish, making caviar and egg-boiling in compost. Additionally, Geitmyra offers recreational courses for kids and families, arranges several open events and has national education programmes. Altogether this totals approximately 15,000 visitors a year. The Oslo schools are concerned about measurements and competence, so all the programmes must follow the school curriculum and include interdisciplinary

courses with themes such as sustainability, ecology, geography, anatomy, mathematics, etc. The manager of Geitmyra explains that teaching children at Geitmyra is a good way of using applied knowledge in concrete situations. Most of their programmes are evaluated by the teachers, and their summer school programmes are evaluated by both the children and teachers. Geitmyra also offers an educational programme called "Edible science" - a taste of photosynthesis, for children who are struggling with regular school science tuition. These pupils visit Geitmyra three times a year.

School tuition does not receive commercial support, but is being paid by the education authorities. They also run events and classes on weekends, afternoons and holidays that are financed by sponsors or by various governmental and commercial partners who make all their courses affordable and do not exclude participants due to low income, including Matvett.no, which sponsored Geitmyra to run a course about leftovers in cooperation and cost sharing.

#### 4.1.6 The Science Centre *DuVerden*

DuVerden is one of 10 regional science centres in Norway and is located in Porsgrunn. The centre is unique insofar as being a combined science and art museum related to marine and maritime activities. DuVerden was initiated by the Ministry of Education in 2003 to make subjects like nature science and math more attractive, and engages approximately six-seven employees. DuVerden has the agenda of stimulating a curiosity about science, technology and maritime knowledge for children and youth through interactive installations, experiences and a joy for science. DuVerden is owned by the Telemark Museum (60%) and the union for technology and science, Tekna (40%). A large part of the funding comes through the Science programme of The Research Council of Norway as part of the government's science initiative.

A large percentage of the visitors at the centre are schoolchildren, but DuVerden is also an attractive place for families and visitors during holidays and weekends. School visits are anchored in collaboration with several municipalities. The offer includes both teacher training and educational programs for pupils, as well as cooperating with the regional teacher training. Through visits, they will raise interest and knowledge of science and history to children and youth through frequent repeated visits. The main target for the centre is to contribute to a measurable increase in the support for science-based education in the region and an increased knowledge and pride of the region's marine and industrial history.

DuVerden aims to have at least 40,000 visitors a year and to have dynamic programmes and a focus on renewal of the exhibitions. Today, approximately 2,000-5,000 schoolchildren visit the centre yearly, mostly from primary school. A funding scheme for sustainable mobility, TransNova, has sponsored the roundtrip bus transport of schoolchildren. They emphasize that all the educational programmes and the staff must be flexible and dynamic when it comes to dealing with everyday situations that occur. According to the general manager of the centre, this flexibility is regarded as a necessity when meeting classes and teachers for the first time, with all the diversity of children and with different amounts of preparation ahead of the visit. The centre continuously evaluates and renews their programmes, as they are very conscious about the quality of their education programmes, preferring a few high quality programmes rather than many halfhearted ones.

### 4.1.7 The blog collective *Grønne jenter*

Grønne jenter (“Green girls”) is a blog collective consisting of nine girls who want people to change their consumerism and make the world more sustainable. On the blog, gronnejenter.no, they share their successful and less successful attempts to be environmentally conscious world citizens. A goal for them is to inspire others toward a green lifestyle that is both fun and cool. Green girls take the pulse of environmental trends, and show the way for more concrete tips and guidance. The blog collective wants to inspire each other and others for changes of attitudes toward a more sustainable everyday life.

In the meeting with one of the bloggers, she emphasized that we need to know about our sustainability contribution obstacles. The following citation captures many of the mental obstacles when it comes to changes in own behavior (translated from Norwegian):

The first obstacle in doing anything is that the climate issue is perceived as distant. Temporal consequences are far away for us living today. The question also feels distant geographically. There is someone else who should do something with the climate problem. We blame it on our political leaders, and they blame us. We end up in an eternal spiral of psychological distancing.

The second obstacle is the great doomsday barrier. We know that fear messages pacify the people. When talking about climate, talks are always in disaster terms. It is inevitable that the helpless public will prevail.

The third obstacle is within ourselves. The climate crisis gives us dissonance. Dissonance occurs when there is disparity between what we think and what we do. It's really uncomfortable and we humans do much to get rid of these feelings. Most often our actions are driven by our attitudes, and not vice versa as many seem to believe. We live in a high consumption society, and our lifestyle is equivalent to this. Now we have the knowledge of what this lifestyle brings with it, but the way we live is the same. Thus, there is a dissonance between how we actually live and how we know we ought to live. We're driving, we're flying and everyone around us does the same. We pump up oil and gas. So how it can be so dangerous?

The good news is that if one is aware of these obstacles, you can turn them into success criteria. By changing distant to closeness, doomsday to positivity and avoiding triggering the need for denial makes it easier to inspire others – and even be inspired to do something about the climate crisis. The rescue operation of the planet must be a social affair. We must make it easy to act appropriately. Drop the doom and gloom, and doomsday prophecies. We feel only more helpless when we are notified that the globe is misguided. We need to talk about climate change as a movement we are already a part of, and that it's something we'll continue to do. And that is something we want and not something we are forced to do.

## 4.2 Examples from England

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### 4.2.1 The Sustainability Centre

The Sustainability Centre is located in Petersfield. The centre aims to educate, enable and inspire people from all walks of life to make positive changes to the way they live and work. As part of this vision, they aim to manage their land, their charity and their businesses as working examples of sustainability.

The Sustainability Centre practices and promotes sustainability as a process of making decisions that balance economic, social and environmental factors for positive benefit, and to nurture people and ideas. Their teaching aims to provide positive messages and practical solutions for dynamic, creative change. In pursuing this goal, they welcome families and schools, professionals and special interest groups, children and young people and simply anyone with an interest in what the centre does. As one example, the centre arranges a Green-fair-day (one-day-festival) with approximately 3,000 visitors. Among the 15 employees, some are volunteers, while others enthusiasts from the grassroots movement run the centre.



The centre raises money through charities and schools who pay for visits, and for school camps at the site. Options like school camps with accommodations in an eco-refit-house, outdoor teaching with themes like ecology, Wild & Natural Nature, biology (habitats, replanting) and geography (land uses change) are all part of the main programme. Unfortunately, according to the education manager at the centre, the government has removed Sustainability from the curricula just recently, which means the training programmes are no longer justified as part of the curriculum.

Most visits are by schoolchildren between the ages of 7 to 11 years, and some 11 to 16 years, who have a "day-visit" at the centre. Target groups are schools within a radius of a one-hour bus ride. The programmes are very popular among "Inner City kids", as the centre offers a multifunctional outdoor classroom experience different from their common indoor education at school.

Core values for the centre are:

- ECO-LIVING: Holistic, depth and social
- Quality
- Days different from everyday school
- Give special feeling of being part of nature
- Storytelling as an important pedagogic tool
- Realism, mixed with doing specific tasks
- Play and discover
- Games
- Eco-building techniques
- Paths with magic secrets

The centre also offers an outdoor education programme with specialized teachers for children who are struggling with schooling. The centre receives financial support from sponsors to these programmes.

#### 4.2.2 Carymoor Environmental Centre

The Carymoor Environmental Centre is run by the Carymoor Environmental Trust, which was set up in 1996 by a small group of enthusiasts. The Trust carries out pioneering land restoration and habitat creation on 100 acres of capped landfill in Somerset. This has created a nature reserve with an extensive range of habitats that is used to provide high-quality, first-hand experiences of the natural world. The centre is located near the active landfill site, and is in a unique location in providing the ideal setting to contrast environmental sustainability with the less sustainable activity of landfill. Through education programmes and demonstrations of renewable energy and sustainable buildings, the centre has developed a reputation of exemplifying environmental good practice according to the chief executive. There is a small and dedicated team working at the centre. Some staff members work in education teams, which are working with school groups of all ages, both onsite and at the schools across the wider region. Their vision is for sustainability to be central to the daily lives of everyone; their mission is to enrich the environment and people's lives through providing unique opportunities to gain positive experiences of sustainability.

Carymoor has been a key provider of environmental education since 1996, and their experienced team delivers a wide range of fun, hands-on activities linked to a variety of cross-curricular topics, including waste and recycling, materials, sustainability, global citizenship, habitats, Celtic life, bush craft, natural and recycled crafts and more. They offer a range of services like daytrips to inspirational site outreach workshops in schools, primary afterschool clubs and school grounds development. Carymoor has been the holder of the Learning Outside the Classroom Quality Badge since 2012, which is the nationally recognized indicator of good quality educational provision. The Eco Centre at Carymoor can accommodate up to three classes per day, and their outreach team can visit two classes per day at local

schools. All activities can be tailor-made to customize the schools' needs. The key curriculum areas covered by workshops are geography, science, design and technology, and citizenship. They also have children's activity parties with fun-packed activity parties for youngsters aged 4-11 years.

### 4.2.3 The Eden Project

Eden is a unique and complex tourist attraction located in Cornwall. The Eden Project is owned by the Eden Trust, and is regarded a social enterprise and charity organization. There are more than 500 people involved in The Eden Project. There is 6½ full-time teachers employed at Eden, as well as flexi-positions working with educational functions regarding art, science, philosophy, math, design, research and storytelling.

The site is an international visitor attraction with a stage to entertain and communicate the mission for Eden: The Eden Project Connects people with the living world and with each other. The magnitude of Eden makes the place comparable to a family park. There are concerts and theme events on weekends and holidays, with credibility and word-of-mouth as their main marketing strategy.

Eden is a metaphor from ditch to Eden, and transformation is a keyword. Solutions exist, and they want to nudge and give options to people, and to give people a good day out by taking on a journey that is memorable and inspiring. According to the education manager, Eden needs their visitors to return as often as possible in order to keep the centre running. The visitors are a broad range of people, and their target group is everybody – not those who are already conscious about the condition of the planet.

Teams of teachers and gardeners with different skills are put together to teach complexity and sustainability to the children. The Eden profile is an “impact on people and planet”, but this is complicated to do within only a few hour visit according to the education manager. They try to make an impact through their 14 different school programmes, which are all based on the Curriculum and Eden Mission. There is no traditional "guided touring" of the schoolchildren, but instead they spin a story to set a challenge so the kids will do research and investigate the place. Priority number one for the education team is that teaching and learning at Eden are “to be serious fun”. The children have fun, play, have quizzes, as well as having silliness and contests that connect the themes to the real world and arouse curiosity through the school's programmes.

A theme for the visit could be spun around a story, a dramatic narrative. The children contribute to the story and make it meaningful, inspiring and engaging. One example of this: Kinder Garden visiting has a 20-minute session where they frame a story around a traditional story like "Stonesoup". Instead of a stonessoup, they must make a rainforest pudding and look for ingredients such as bananas, cocoa, sugar and so on. They all get a necklace with a map and activities. Examples of programmes are for children aged seven-eight years, who have a programme about food called "The Crazy Chef Challenge", in which they must find the recipe to make a delicious cake from ingredients all over the world by using a map and a book of clues to fill up a basket with the ingredients. They then talk about where all the ingredients come from, and at the end, they eat the cake. Twelve-thirteen year olds have a programme called “Plant adaptations”. This is about extreme sports and people, and they were given clues about how plants adapt to survive.

## Examples from Denmark

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### 4.2.4 Wastelab, Vestforbrænding

WasteLab is Vestforbrænding, which is comprised of teaching facilities located in Copenhagen. It is for students in the 8th-10th class and college, offering two-day courses aimed, respectively, to science. The courses at WasteLab take parts of learning in WasteLab and other parts of the incinerator, where students can use their senses when they see, hear and smell through the processes. Many of the processes are hidden in pipes, tanks and the like, so much is made of dissemination, using posters and models that illustrate and clarify the technical processes. WasteLab is a universe of different sensations that allows students to learn about waste. Students learn about the welfare benefit that follows when Vestforbrænding treats the waste. At the same time, a lecturer is in a dialogue with students about their waste, so that students become aware of the importance of their own efforts regarding what they buy and how they recycle. Students have different learning needs, which WasteLab takes into account in several ways. Most of the work is done in groups, so that professional communication between students is supported.

One example of an education programme for pupils from 15-16 years starts out with an introduction, and after that the pupils are given headsets, safety vests and helmets. Next, they are given a guided tour through the factory to see the processes and the facility. Along the way, some workers intervene by telling their “side of the story” and facts. After the tour, they have a short break and a snack provided by Wastelab. The class is then divided into five lab groups. They have five different stations, including chemical experiments, with all groups managing to do three-four of them. After a lunch break, all the groups are given a presentation, each from one of the five stations. They knew ahead of time what lab experiments were going to be presented to the rest of the class.

### 4.2.5 Amager Resource Centre

The Amager Resource Centre (ARC) is a partnership owned by five metropolitan municipalities with a vision to be the future value-added manager of resources in waste. While working for the vision and doing business, they take responsibility for how to affect their surroundings. The ARC proactively contributes to solving some of the world's social and environmental challenges, in addition to maintaining a high respect for operations and business. The ARC has a collaboration with the engineering education at the University of Copenhagen to develop future recycling and waste management towards better solutions for the future.

The Amager Resource Centre has a variety of educational programmes for schools. The programmes are organized in many different ways depending on the subjects, grade levels and methods. Before the visit, the ARC recommends the free e-learning website ([affald.dk](http://affald.dk)), where there are games, tasks, films, articles, Web Quests, proposed education suggestions and much more. The site offers prepared teaching materials and teacher's guides for all grade levels and almost all subjects in primary schools, such as science/technology, physics/chemistry, biology, geography, Danish, English, mathematics, social studies, music, history, crafts and design, visual arts, food and health. Schoolchildren are invited to the real working space, and can receive teaching programmes at recycling centres, incinerators and landfills across most of the country.

Examples of school programmes at ARC:

- “Visit your recycling station”, and learn how to sort and navigate the recycling centre.
- “Future Green”, to find out where things come from and why sustainability is important.
- “Raiders of Mineral Resources”, with games that help you learn about mining and sustainable development.

The ARC has ambitious plans for the future when it comes to the educational centre in conjunction with the new combustion plant. There will be a 10-story high visiting centre with a ski slope on the roof and a climbing wall, which will open in 2017. The centre will show the technology and give the visitors a chance to reflect upon all the waste we produce, and confront their own consumption pattern. It will be open to schools, students, subject-relevant guests, politicians, international delegations, NGOs and people just passing by, and will have communicators hired on an hourly basis. Nature science education will be presented with the approach that learning should be fun. Their strategy is a zero bad conscience, but to give a friendly nudge in the right direction and focus on various possibilities. In line with this, the learning is to be creative through play and experiments, including hand, body and head, formal and informal education – all integrated into school education and curriculum.

# 5. Cooperation with educational institutions

## 5.1 Collaboration between The Magic Factory and the University College of Southeast Norway

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The first contact between Vesar and the “Faculty of Humanities and Education” at the “University College of Southeast Norway” (HSN) regarding The Magic Factory was established in September 2015. Collaboration plans were developed through conversations between representatives of Vesar and HSN. The leader of the “Institute for practical and aesthetic subjects” and the dean were soon included in the process, and a collaborative agreement between Vesar and HSN was signed. Such a formal agreement is regarded as important in order to support diverse forms of initiatives that can include teachers/researchers with their students when it comes to the development of methods toward sustainability teaching and learning. Soon after this agreement, a number of teacher educators/researchers from the “Institute for practical and aesthetic subjects” expressed their desire to join the collaboration. In this first turn, teacher educators/researchers presented the following school subjects: music, art and crafts, drama, food and health and physical education. Teachers from other institutes also expressed their interests. Parallel with the establishment of a new larger university college that now included eight campuses, the collaboration with The Magic Factory became familiar to other campuses, departments and institutes within the new HSN, resulting in a large potential for collaborative research within the HSN and synergies that could contribute to the development of knowledge of national and global interest.

In January 2016, a workshop was arranged for students in “Master in pedagogical resources”, together with teachers from diverse disciplines, including pedagogy, language studies and science. The main objectives of the workshop were: 1) to motivate the students and teachers to engage and contribute in some kind of knowledge development; and 2) to collect impulses and suggestions for the further development of facilities and pedagogical resources at The Magic Factory. The workshop contributed to an enlarged awareness of The Magic Factory, and inspired some of the students for their work with related assignments (15 study points).

The programme, “Master in pedagogical responses”, is affiliated with the “Institute of practical and aesthetic subjects”. The master study has been appointed as one of the possible ways to include teacher students from HSN in the development of educational methods for The Magic Factory. However, due to national changes in the teacher education programme, this master will not be offered to any more students (according to the national requirements, only master’s degrees with a focus on single school subjects will be allowed). This means that the master is no longer relevant, but many other and larger possibilities have been initiated after the first contact between Vesar and HSN. Besides the diversity of ways to include students and teacher educators/researchers, a PhD student’s position in “Pedagogical resources for sustainability” has been employed with the purpose of developing knowledge directly related to The Magic Factory.

In March 2016, a research group was established at HSN within the “Faculty of Humanities and Education” in order to coordinate and support research related to The Magic Factory. The research group is called “Teaching and Learning for Sustainability” (LETS). All contributors from HSN into this pre-project are also contributors and leaders of LETS, and are representing different campuses and subjects (art and crafts, pedagogy, ecology). The main aim of the LETS research group is to support the development of pedagogical approaches that can motivate learners to engage, take an initiative and act

with responsibility towards their local and global environments. LETS aims to support and encourage pedagogies that are interdisciplinary, collaborative and real-life oriented, with a focus on experiential and holistic forms of learning. The term “holistic” refers to the acknowledgement of emotions, senses, individual’s experiences and creativity as integrated aspects of every process of learning and teaching. Innovative ways of teaching and learning are needed in order to change values on a deeper level and to motivate learners’ social responsibility.

The collaboration with Vesar has already been put into motion. Smaller scale research projects thematically related to The Magic Factory have been carried out in preschools (May and June 2016) and schools (September 2016) in the area. The project has thus far resulted in three conference presentations this fall (in Finland and Norway), and one research article/book chapter, “Teachers as gatekeepers and cheerleaders: Empowering young people to engage with sustainability through the cultivation of future-focused creativity” for the book, *Youth as architects of change: Global efforts to advance youth-driven innovation for social change*. There is large potential for the involvement of researchers from HSN who are still not familiar with The Magic Factory and LETS. The Magic Factory and LETS have been presented at a personnel seminar for the entire HSN in Sandefjord in June 2016. The seminar presentation led to participants taking the initiative to request the new dean to set up a one-week seminar for teacher educators/researchers in order to introduce sustainability into the development of curricula. National revisions of teacher education require “sustainability” to be one of the main themes across school subjects. The theme is now being implemented in the local HSN curricula plan process taking place at the moment. The leaders of HSN have shown an understanding that the development of methods for teaching and learning for sustainability should have an important position in the new HSN.

## 5.2 Workshops directed toward kindergardens, elementary schools and high schools

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The project group invited employees and teachers from kindergardens, elementary schools, middle schools and high schools to participate in a workshop. The purpose of the workshop was to tell about the status of The Magic Factory, and to provide the possibility to give feedback, get involved and contribute to the development of an innovative and creative future educational programme at The Magic Factory. The input and feedback from the workshop will be used in the pedagogical and practical development of the arrangements at the centre.

The main questions for the workshop were:

- Part I: *What will be important teaching elements and topics for an outside classroom teaching arena?*
- Part II: *What are promoters and obstacles for collaboration with The Magic Factory?*

### **Workshop Part I:**

In this part, the participants were divided into groups representing kindergardens, primary schools and high schools. The participants were asked to write keywords on post-it notes regarding important teaching elements and topics for The Magic Factory. Keywords and statements from the groups were:

#### a) Kindergarden:

To do research, since the children will wonder: “What is a biogas factory?”, “Where does the garbage vehicle take the garbage and where does the content go?”, “What happens to plastic waste?” We want the children to be active participants, and to be involved in a “transformation process”. Maybe cook something? Maybe sow seeds? See that food waste is being processed into new materials such as biogas and bio-fertilizer. Exhibit things the kids will make when visiting the factory. Do arts and crafts from

waste. Have a machine that shows what happens at the factory. Create a magical machine that when you put something in it turns the thing into something else. Make a miniature of the city Tønsberg in recycled materials. Use 1:1 illustrations to show the decomposition of different materials. See the recycling process of paper.

b) Primary school:

Wondering, searching workshop, experience, feel, sense, touch! Interdisciplinary, subject-specific, learning objectives, linked to subjects and steps. Conversely, work with the curriculum. Organize practical tasks first, then systematize them in a qualification analysis (curriculum set in form). Learn about composting. Earthworms. What is soil? From the farm to the table. See the entire process. Circulation. It must not be an isolated experience, but tied to the curriculum and part of the school year, with good preparation ahead and a follow-up after the visit. Pupils should create an environment blog, journal or newspaper, as well as initiate an environmental project that is foreseeable. Researching the different fertilizer types of, e.g. tomatoes. Learn about biodiversity in a pond or a forest with birds, insects, trees, plants and soils. Learn about gardening and cultivation. Make them feel affiliation and ownership. Maybe start up something on the first visit that one could follow in the years ahead, e.g. plant a tree? Get a memento? A plant? Learn about the buzzing life. What do plants need? What is air purification and water purification? What can garbage become? What do I have that has been recycled?

c) High school:

Create awareness as citizen of the future sustainable society. How can- and should the state, business sector or I take the responsibility? What are the future professions and occupations? Create an interest in technology in a sustainable society. Learn about the production process. Prepare for the visit. The curriculum pinned teaching subjects linked to years of schooling, specified on subjects and the interdisciplinary learning curve. Do research and laboratory tests that run over time. Collaborate and do virtual follow-up tests together with the laboratory at The Magic Factory through a live camera over time. Measure temperature, light, nutrients, nutrient supply, CO<sub>2</sub> and manipulate growing seasons. Cover curriculum goals. Challenge existing theory. Create future career opportunities in areas connected to working in a biogas factory or at a high technology greenhouse. Do technological research. Biology 2 themes: photosynthesis, cell respiration, element the circuit C -N - P. Prepare the basis for a new field of study according to the new curricula "sustainable development" and the new discipline at Greveskogen called: Green TAF (Technology and research) for "The young scientist".

### ***Workshop Part II:***

In this part of the workshop, the participants were asked to share what they consider as promoters and obstacles for a collaboration with The Magic Factory. Table 1 summarizes the keywords about perceived promoters and obstacles amongst the workshop participants. Overall, they find that The Magic Factory can offer a practical and experience based way of teaching according to the curricula, but that finding time for the visit and related work takes is a barrier.



Table 1 Percieved promoters and obstacles for a collaboration with The Magic Factory

	Promoters	Obstacles
All	<p>Do something practical. Physical exercises. To make something. Measuring instruments, tools, materials, to research, experiment, filming, observing</p> <p>Info in advance (online or folder). Ability to follow-up return to an undisclosed location.</p>	<p>Transportation and time. Be allowed by the school to be gone entire day</p>
Kindergarden	<p>Parental involvement Planning day. Staff at the factory.</p>	<p>Transportation.</p>
1-7 grade	<p>Interdisciplinary curriculum. Energy one of the main themes in 6<sup>th</sup> grade. Connect to the theory/classroom teaching. Possibility of local research project initiated in connection with the theme. Participate in green change. Free transportation. Short distance. Time, needs planning in advance.</p>	<p>Must be adapted to aim and strengthen the theory teaching. Time to the implementation of pre- and post-production. Cost of transport. How to create enthusiasm among colleagues. Fear of time thieves: "Do not take my time".</p>
8-10 grade	<p>Experiencing with all senses. Smells, see, hear, taste, feel. See how reality works, and where products end up after disappearing in the garbage/ compost.</p>	<p>-</p>
High school	<p>Colleagues who are positive. Teachers with expertise. Interdisciplinary learning. Relevant in all subjects. Basic skills, competence. Geography/location. Students are very positive about fieldtrips. A better way in illustrating theory. Natural sciences. More and better learning. School environmental certification, schools wants to spend time on this.</p>	<p>Time pressure (entire days). The time we have at our disposal in the course of a week. Trip should be added in the annual plan Ownership among teachers. Anchoring this with the leaders. Money for travel and accommodations. Disance. The word "Magical" assumes that expectations are met. Is it magical enough?. Information. User friendly? Collaboration between business industry and schools.</p>

# 6. A model for collaboration

## 6.1 The Magic Factory

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The idea for a centre for visitors, The Magic Factory, was developed by creative individuals at Vesar, not knowing whether similar educational centres existed nationally or internationally. However, as seen through this pre-project, there are several initiatives and attempts to facilitate educational activities other places. The results from searching on the internet for examples of educational sites, depends on an ability to predict which concepts might be relevant – one can therefore never say for sure that similar initiatives do not exist, not to mention initiatives that are named in foreign languages. For examples exist a number of “Landfill Site Environmental Resource Centres” in the UK, but it is not obvious what kind of activities these centres have.

Drawing on existing knowledge and teaching theories, as well as on what we have seen and heard from the places we have visited and people we have interviewed, the following pedagogical dimensions for The Magic Factory can be outlined:

- The Magic Factory promotes a holistic approach to environmental education. This means that methods of learning and teaching for sustainability build on arts-based related activities that facilitate young learners’ emotional engagement and a physical action that involve all the senses and the entire body, and builds on a democratic participation that awakens a sense of responsibility.
- The Magic Factory builds on an ecological philosophy that tends to dissolve a dualistic understanding of humans and rest of the natural world, in addition to works against a current distribution of power between humans and non-humans that exists, as I present cultural-historical contexts (and has been the most influential for thousands of years).
- The Magic Factory deals with educational methods which acknowledge that inter-subjectivity between a teacher and student is essential for learning, which acknowledges the specificity of each context as a foundation for what is possible to grasp on an individual level and prizes each individual’s experiences as a valuable contribution and force of empowerment. Moreover, the learning process (the process of a continual negotiation of new understandings) is an ongoing process, constantly influenced by emerging realities.
- The Magic Factory is transforming public institutions into site-specific learning facilities. The architectural elements as the built environment become important parts of the experience and for strengthening the stories.

Hence, the development of appropriate educational methods is not about the development of a method or set of methods and curricula content, but about the development of mindsets and values in teachers. “We teach who we are”, says Stinson (2002). Each teacher teaches based on who she or he is. The project must therefore focus as much on teachers as on students, in order to enhance engagement and enthusiasm amongst teachers.

## 6.2 A Magical Learning Model

From the data collection and the pedagogical dimensions The Magic Factory (chapter 6.1) are formulating a learning theory for the centre. This theory intends to inspire students and teachers based on a magic way of thinking and acting, and the model has four parts: 1) re-enchanting, 2) re-wondering, 3) re-viving and 4) re-telling. At the heart of The Magic Factory is the word “magic” and “fantasy-ic” (“fantasi-isk in Norwegian”). A magic learning model searches to be both magical and fantasy-ic (using the fantasy of the kids), so that when the kids have visited The Magic Factory, and they are asked what they thought about it, they will respond: “It was magical and fantasy-ical!”

Figure 1 illustrates the model, followed by a description of each element of the magical learning theory to be developed and implemented at The Magic Factory in the future.

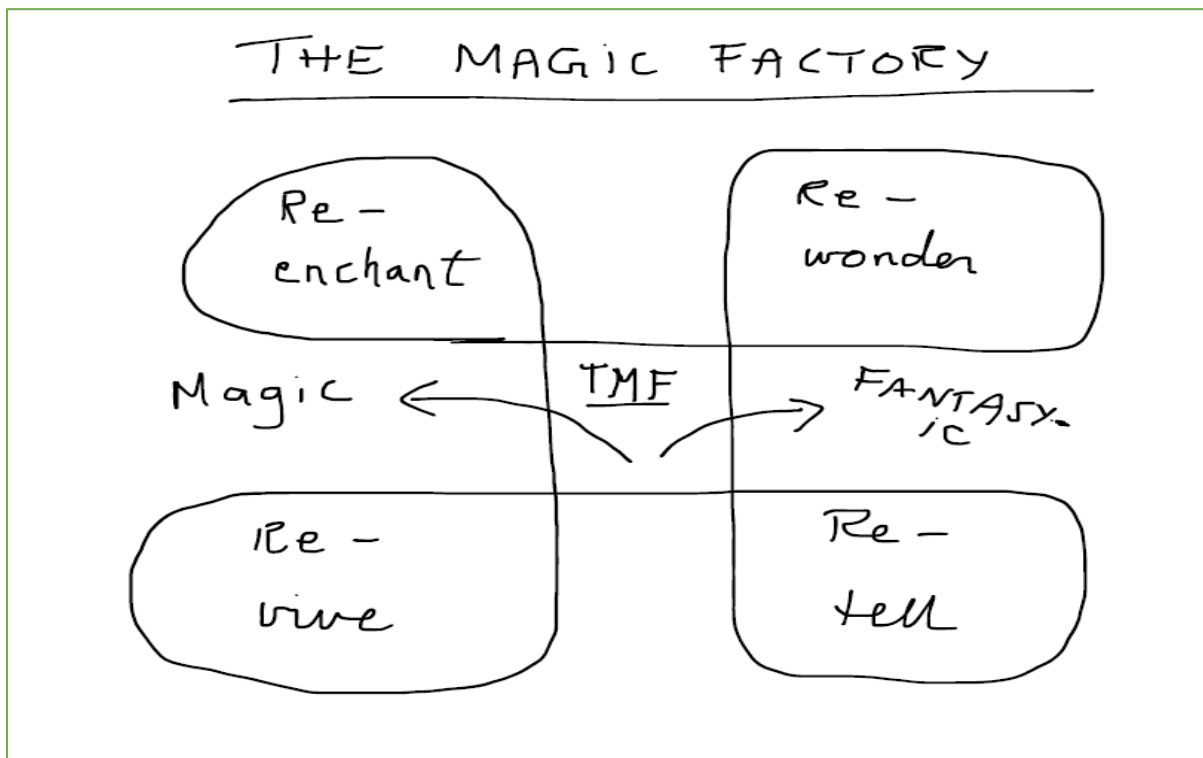


Figure 4 Sketch of The Magical Learning Theory

In the following, there is a closer description of each of the elements of the magical learning model:

- 1) Re-enchantment: Enchantment has to do with something that feels wonderful, surprising and something that has a magic spell to it. Learning and teaching need to be open, improvisational and attempt to have the element of surprise.
- 2) Re-wondering: Learning starts with wonder and ends with wonder, so to wonder is something that underlies all learning in The Magic Factory.
- 3) Re-viving: This has the element of bringing back to life something that has died, and is linked to revitalization, and which aims at the transformation that takes place in learning.
- 4) Re-telling: This aims at both the art of storytelling, to make stories, small and large, and for students/visitors to participate in making stories. But it also is about “counting” – the teller, which looks at what can be scientifically measured. It opens for both qualities and quantities in the learning process.

Underlying this, and feeding back into it, is the essence of recycling, which is at the core of The Magic Factory, and it is that which the magical learning theory is both built on and contributes to. This is also directly linked to the concept of circulation and circularity, which we find again in “circular economy” and “recirculation”. The model is to be operationalized in the context of didactic relational thinking when implemented at the centre.

## 6.3 Concluding remarks

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As we understand, how we teach has an impact on the learning process, and in this project we have been searching for a pedagogical model able to transform how the world is perceived, and how we act in regard to new knowledge and understanding of environmental challenges. Such an effort is important in order to realize the societal changes necessary for sustainability transitions, as establishing infrastructures and political willingness are not sufficient enabling factors for a broad green shift in society.

As this pre-project finds, there are many institutions teaching for sustainability, and we have built on their experiences and theoretical perspectives when formulating a “magical learning theory” and transformative teaching methods. The real-life circular economy, which the knowledge and experience centre The Magic Factory is communicating and inviting into, is an example of multilevel collaboration for sustainable development. Furthermore, The Magic Factory is framing a unique concept for creative teaching for sustainability with its physical and holistic environments. The aim for the near future is that the teaching approaches being elaborated on in this pre-project will be subject to further development and implementation, as well as effects on attitudes, motivations and behavior being evaluated. The collaborations with kindergardens, elementary and high schools, as well as the teachers education are established, and The Magic Factory can begin their teaching.

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# Further resources

- [Klimakalkulatoren.no](http://Klimakalkulatoren.no)
- [Globalis.no](http://Globalis.no)
- OECD def. of competencies: see [oecd.org/ education/skills-beyond-school/definitionandselectionofcompetenciesdeseco.htm](http://oecd.org/education/skills-beyond-school/definitionandselectionofcompetenciesdeseco.htm)
- [www.p21.org](http://www.p21.org): future skills
- [Sustainabledevelopment.un.org/globalsdreport/](http://Sustainabledevelopment.un.org/globalsdreport/)
- IPCC. Intergovernmental Panel on Climate Change, from 1988. Peaceprize 2007.
- [www.miljolare.no](http://www.miljolare.no)
- [Greenudge.no](http://Greenudge.no)
- [Fornybar.no](http://Fornybar.no)
- [Solenergi.no](http://Solenergi.no)
- [Miljojournalistene.origo.no](http://Miljojournalistene.origo.no) (dagsaktuelle problems)
- [youngreporters.org](http://youngreporters.org)
- [Klimamote.no](http://Klimamote.no) (rollespill om klima i skolen)
- [Klimaspillet.com](http://Klimaspillet.com) lar elever spille roller rundt klima
- [Teknologiradet.no/vare-metoder/lekfolkskonferanse](http://Teknologiradet.no/vare-metoder/lekfolkskonferanse) (måte å ta opp temaet i rollespill)
- [Dramaiskolen.no](http://Dramaiskolen.no)
- [Natursekken.no](http://Natursekken.no) (flere eksempler på 5E modellen i skoler knyttet til. ESD)
- [Naturfag.no/5E](http://Naturfag.no/5E) (more details about the 5E model)
- [Forskerfro.no](http://Forskerfro.no) inquire based teaching
- [Context.org/iclib/ic18/johnson/](http://Context.org/iclib/ic18/johnson/) (om samarbeidslæring)
- [Kortrestgjestebed.no](http://Kortrestgjestebed.no) (om Tingvoll skole eksempler med mat i læring)
- [Fao.org/home/en/](http://Fao.org/home/en/) (skolehage)FNs matprogram
- [Norgesskolehagelag.no](http://Norgesskolehagelag.no)
- [Skolehage.no](http://Skolehage.no)
- [Bioforsk.no](http://Bioforsk.no) (temasider om skolehager)
- [Ecoliteracy.org](http://Ecoliteracy.org) (examples of developing knowledge and skills and competencies )
- [Kbhskolehaver.dk](http://Kbhskolehaver.dk) (skolehager i danmark)
- [Matmerk.no/inn-pa-tunet](http://Matmerk.no/inn-pa-tunet) (eksempler på gårder som brukes som læringsarenaer).
- [Friluftslavn: lovdata.no](http://Friluftslavn:lovdata.no)
- [Miljodirektoratet.no](http://Miljodirektoratet.no) (temasider om friluftsliv og allemannsretten)
- [Dnt.no](http://Dnt.no) (eksempler) for skolene
- [Friluftsråd.no](http://Friluftsråd.no) (friluftsrådene jobber for bevaring av friluftsområdene)
- [Kartiskolen.no](http://Kartiskolen.no) (skrive ut kart når man skal på tur)
- [Uteskoleveven.no](http://Uteskoleveven.no)
- [Naturoppsyn.no](http://Naturoppsyn.no) (naturveileder)
- [Natursekken.no](http://Natursekken.no)
- [Miljolaere.no](http://Miljolaere.no) undervisningsopplegg.
- [Globe.gov](http://Globe.gov) (Global learning and Observations to Benefit the Environment) et verdensomspennende naturfaglig undervisningsprogram for å øke miljøbevissthet.
- [Vitensenter.no](http://Vitensenter.no)
- [Kulturradet.no](http://Kulturradet.no) museer
- [Miljodirektoratet.no/no/Tema/For-skole/miljoambassadorer/](http://Miljodirektoratet.no/no/Tema/For-skole/miljoambassadorer/) (kan besøke skoler å holde foredrag)
- [Fee.no](http://Fee.no) (grønt flagg for skolene)
- [Miljofyrn.no](http://Miljofyrn.no)
- [Miljoskole.no/ungdom/video/en-skole-blir-gronn/](http://Miljoskole.no/ungdom/video/en-skole-blir-gronn/) (eksempel)