Children’s systems telling and the story of a meatball’s social-ecological system

A narrative approach to systems thinking in early childhood education for sustainable development

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And to you, the reader. Bless your food, enjoy life and be kind.
Abstract

The aim of this thesis is to investigate how young children’s narration of an everyday object, the meatball, is a beneficial approach to systems thinking and if something emerges that could be useful in education for sustainable development in early childhood education. In a world of complexities, our role as participants in systems encompassing food, energy and waste is neglected in favor of drawing attention to individual events. Systems thinking is about understanding complexity, a key aspect of the resilience approach to sustainable development. Research shows valuable return-on-investments from early childhood education for sustainable development, but the field lack academic attention. The research method is case studies at pre-schools based on narrative inquiry. The study creates situations where children explore their own boundaries. Findings show that humans are largely missing from the children’s social-ecological system and a difference in the approach of acknowledging uncertainty vs. imaginary explanations to phenomena surrounding a meatball. It finds that zooming out from one familiar object is a simple way to introduce systems thinking in early childhood education and that narration is a useful approach to identify knowledge gaps.

Keywords: Early childhood education for sustainable development, systems thinking, systems telling, narration
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1. Introduction

“In the end, meatballs. 

After you’ve eaten a meatball it ends up in your tummy. There, the meatballs lie down and listen to your heartbeat. The meatballs are happy.”

*It begins at lunch*

This thesis is not about meatballs. However, it will take advantage of the meatball as a tool to introduce pre-school children to the social-ecological system that this fairly popular, everyday item is a part of. It will also use the meatball to try to make the serious nature of food production, energy, waste and sewage treatment, somewhat more amusing. As Pramling (1998), suggests, it is not about scaring children by highlighting the environmental consequences of a contemporary lifestyle, but rather “creating respect for the resources of the world among the children and making them realize that they can influence the environment in their own surroundings” (p.83).
Connecting the dots

This thesis is structured around the following line of thought: education for sustainable development, as the term indicates, is about educating humans in regard to sustainable development. Sustainable development is in turn dependent on social-ecological resilience (Folke et al., 2002). Resilience is about system dynamics (Walker, 2004; Folke, 2006), and in that, about systems thinking (Walker and Salt, 2006). Thinking in systems, asking what something is a part of instead of breaking it down to its smallest component, is a way of understanding complexity (Ackoff, 1974; Ackoff and Rovin, 2003; Ackoff and Greenberg, 2008; Bay-Yam, 2004; Meadows, 2008). Narration is another way to make sense of complexity and composing our worldview (Bruner, 1986, 2000, 2002). Alas, the narrative approach will be used to describe the world’s complexity, in this case the social-ecological system of a meatball. We might call it systems telling. Case studies are conducted with 5 and 6-year-old preschool children to see whether storytelling could be a beneficial approach to systems thinking and if something emerges that could be useful in education for sustainable development in early childhood education.

Imagine a world of respect, caring and fascination

Creativity and enthusiasm are rarely mentioned when speaking of or learning for sustainable development. It is this researcher’s belief that it would be most beneficial to widen the field beyond switching off lights and sorting paper from plastics. The narrative format used in this thesis utilizes the human imagination and encourages new ideas (Bruner, 1986). As Ackoff and Greenberg (2008) write: “Every significant development in modern science can be traced directly to a fantasy that defies common sense and seems absurd, even now, to people with two feet planted firmly on the ground” (p.45). Let’s start now, regardless of age, to use our imagination in making sense of the world and what it could look like. And by that practice, instill in the mind of the thinker or teller, a world of respect, caring and fascination.
1.1 Problem statement

Given the transdisciplinary and systems approach to the thesis subject, the problem statement is broad and multifold. The meatball itself may not be a problem, but as a food item it is part of a complex social-ecological system people rarely take the time to think about.

Challenges in food and agriculture (Eat less meat)

The meatball represents the problem with the food system in general and meat consumption in particular. Stokstad’s (2010) research show that animals and their protein rich products make up 15% of the world’s calories, yet, directly or indirectly, use up to 80% of the agricultural land on earth. An argument for eating less meat is thus that the plants that are used to feed cattle, could feed a substantially larger number of people (Stokstad, 2010). According to Godfray et al. (2012) the key challenges within agriculture and food security are to eradicate hunger and malnourishment as well as matching rapidly changing demand for food from a larger and more affluent population. And, fulfilling these two goals in an environmentally and socially sustainable way, thus not maximizing productivity on the expense of biodiversity (Godfray et al., 2010). For food, this implies grand changes in production, storage, processing, distribution and access (Godfray et al., 2010).

Waiting for innovation, lack of holistic perspective (We can be change agents too)

There is hope in innovative scientific and engineering solutions in order for development to be sustainable (Godfray et al., 2010). Researchers acknowledge that solutions to the food and agricultural challenges include economic, political and social factors (Ash et al., 2010), although an approach of primarily technological reliance is limited. There is a passive aspect of waiting for engineers to innovate, when social and democratic issues also are a part of the solution (Tsevreni, 2011). One could argue that the underlying reason for a majority of today’s problems is an addiction to quick fixes and lack of a holistic perspective (Ackoff, 1974, 2003). There remains plenty of opportunity for development in the human capacity to see the whole, with its complexity and interconnectedness (Meadows, 2008). In order for short-term-thinking humans to grasp longer...
time frames systems thinking is required (Walker and Salt, 2008). According to Bar-Yam (2004) this is about “recognizing the power of our complex collective” (p. 273).

**Out of sight, out of mind (Great progress, though)**

In a different part of the world or in an earlier Swedish society, not further away than a generation or two ago, a similar study of the meatball (asking children what it is made of, where it comes from, what happens when we throw one away or flush it down the toilet) would have been banal, or simply irrelevant. At that time, most people knew the cows, the farmer and the butcher by their names, and from what part of the globe they originated. According to the Millenium Ecosystems Assessment (MA) population growth, urbanization, economic and technological development during the past 50 years has led to unprecedented changes in ecosystems and a loss of biodiversity (2005). At the same time a large part of the human population enjoy the luxury of electricity and sanitation, with a simple turn of a knob or push of a button. Sandell (2003) argue that we live in a “out of the wall” society, where the wall socket is the provider of everything we need. These revolutionary services, while adding immense health benefits and raising standards of living (MA, 2005), have also had the effect of out-of-sight, out-of-mind-ing a substantial part of the resources needed, and the waste produced as a consequence, in modern everyday living. Describing the world today, Harford (2011) claims that “the complexity of the society we have created for ourselves envelops us so completely that, instead of being dizzied, we take it for granted” (p.3).

**Forgetting play (Good participation)**

Good leadership is constantly sought after, but in modern society we often forget the importance of good participation. Participation requires sensitivity to your surroundings, understanding the workings of the system you are in, or that you would like to change (Chawla, 2009). Like children’s play it is continuously evolving and you need to communicate clearly what new rules emerge or elements are introduced. Play, according to Franzén-Halvars (2010): “demands complete presence and responsiveness. It is created as it evolves. It challenges what is taken for granted and whatever order that rules“(p. 167). Improvisation artist master this skill, of throwing themselves into the
unknown, and together create a story that no one knows how it will end until it’s over (Chawla, 2009).

**Excluding young children (Investments in early childhood pay off)**

Childhood is often looked upon as a time of innocence, and it is therefore often suggested to avoid uncomfortable subjects such as the degradation of the planet’s natural resources (Duhn, 2012). Although we are all toddlers at some point in our lives, researchers argue that childhood is merely a social construct, and the notion of this period in life varies significantly through history, societies and ethnicity (Barratt Hacking, Hacking and Scott, 2007). The problem is that children are not viewed as the stakeholders, and change makers, that they should be in the environment (Barratt Hacking et al., 2007; Davis, 2009). There is also growing research on children indicating the substantial return on investments in education for sustainable development, on both individual and community level (Davis, 2009) and the earlier ages, the greater impact (Siraj-Blatchford, Smith and Pramling Samuelsson, 2010). Not to mention that the values and behaviors instilled in our primary years much shape our future selves (Pramling Samuelsson and Kaga, 2008).

**1.2 Aim of thesis**

The aim of this thesis is to investigate how young children’s narration of an everyday object, the meatball, is a beneficial approach to systems thinking and if something emerges that could be useful in education for sustainable development in early childhood education. If creating meatball stories can be the starting point for seeing a broader system, it could as well apply to the birth and afterlife of a papaya, a shoe or any of the multiple phenomena we surround ourselves with.

**1.3 Research questions**

What narratives emerge when young children talk about a meatball?
In what ways do the narratives relate to systems thinking and a social-ecological resilience perspective?
2. Theoretical framework

This section presents a brief summary of relevant literature, the thesis’ contribution to the field, definition of key concepts as well as the analytical framework.

2.1 Summary of relevant literature

There is a general lack of research directed towards early childhood within the field of education for sustainable development and systems thinking. Julie Davis et al. (2009) would go as far as saying that early childhood education for sustainability is “seriously under-researched”. Davis (2009), quoting Reid and Scott (2006), would even argue that there is a research ‘hole’ when it comes to the issue of environmental education on a kindergarten level.

From research on children to research with and by children

In her research, through a preliminary survey, Davis (2009) found few studies in the overlapping area of environmental education and early childhood. “Hardly any” looked upon education for the environment, and seeing young children as change agents (Davis, 2009). What she found were either studies concerning children in the environment or education about the environment (Davis, 2009). This view is shared by Barratt Hacking et al. (2007) who suggest a shift in social sciences from research on children to research with and by children.

Start with objects of children’s interest

Siraj-Blatchford et al. (2010) have in their research found that even young children are capable of sophisticated thinking. They state the importance of using the children’s interests, or objects of interest, as a starting point. Pramling and Mårdsjö (1998) have conducted previous studies with the aim of raising awareness of the non-disappearance of things and similar to their approach, the case
studies in this thesis also ask: “Where does our food come from?”; "What are we throwing in the trash bag?” and "What happens to the garbage?” (p.80-81).

Widen the perspective

Dahlberg (2002) (quoting Gore, 1993; Giddens, 1994) states the pedagogical challenge to stimulate and encourage a self-reflecting approach to the present and the future. In her research on young children she includes the societal changes, from an industrial society to a learning information and knowledge based society. This shift requires reflection and a deeper analysis of the challenges we are facing (Dahlberg, 2002). Dahlberg (2002) also emphasize the social-constructivist perspective with the child as a co-creator and the emancipatory potential of human beings in changing ourselves through our actions. Tsevreni (2011) suggests that contemporary environmental education and its emphasis on scientific knowledge fail to identify social and political dimensions of the ecological crisis Although Tsevereni’s article focus on older children, urban planning and empowerment, it offer criticism towards solving environmental problems mainly by technological or economic methods and request a wider perspective. Duhn (2012) mentions the “pedagogy of place”, and that the area for learning does not stop at the front gate, but is a process incorporating both the local and the global. Pearson and Degotardi (2009) emphasize a holistic approach, with global perspectives and participation and would like to shift the spotlight towards the community.

Learning and complex systems

Elliott and Davis (2009) make a point that one of the blind spots in research in regards to education for sustainability and early childhood is that the human/nature relationships are complex rather than dichotomous. They even suggest that systems theory offers a new theoretical space for research and thinking about early childhood education for sustainability. Cindy Hmelo-Silver (2000, 2004, 2007, 2008) have in various partnerships studied different approaches to learning and complex systems, but not on a pre-school level. By investigating the understanding of complex systems and the barriers to understanding them, she has found that learners focus on superficial details, but find it more difficult to see the underlying structure (2005). Hmelo-Silver (2005) claims that “to promote
deeper understanding, we need to provide opportunities such as conceptual models for students to reflect, reorganize and broaden their repertoire for causal understanding” (p.3).

Analyzing drawings and narratives

Analyzing drawings and writings in regard to children’s relationship with nature, and how to understand these better, has been done by Kalvaitis and Monhardt (2012). Although the study compared illustrations and stories of children from different grades, the authors stress that further research also take into account culture, location and socioeconomic factors. Bowker (2007) investigated the drawings of a rainforest before and after an “out of schooling learning experiences” and found that children can learn a lot during shorter, but dynamic, workshops. A Swedish example that offer a creative and playful approach to more complex phenomena are Dackeus and Furness pre-school study “Rådjurets återfödelse till tonerna av mögelmusik”. In it, art is used for drawing out explanations to what happens with a decaying body of a dead deer that the children found in the woods. On a related note, Bigger and Webb (2010) has studied writers of fiction for young people to explore the educative potential of narrative to encourage environmental engagement and stories as a part of the educational process.

Beneficial transdisciplinary collaborations

Both Barratt Hacking et al. (2007) and Davis et al. (2009) stress the benefits of environmental education for early childhood research to be conducted through transdisciplinary collaborations, to work closer with other groups, with research that is participatory and action centered.
2.2 My contribution

My contribution is mainly the transdisciplinary approach. I am investigating how young children’s stories of a meatball’s can be described in terms of systems thinking and analyzed from a social-ecological perspective. My background is not in education, nor pedagogy, and the combination of several academic fields, targeted towards early childhood education for sustainable development, will hopefully make a small contribution to the current ‘hole’.

2.3 Theories and definitions of key concepts

The aim, to see if storytelling is a beneficial approach to systems thinking in early childhood education, and the analytical tools used to investigate this, are based on theories of education for sustainable development, resilience, systems thinking and narrative.

Definition of key concepts

Meatballs

Meatballs are a dish. Meatballs are usually made out of ground beef or pork, spices, bread crumbs and onions, rolled into balls of an average diameter of 3 cm. The balls are cooked in a frying pan. In Sweden it is considered one of the national food items, although the concept exists in a multitude of other culinary cultures (NE, 2012).

Social-ecological systems (interlinked social structures and natural resources)

A social-ecological system is any system that includes both humans and nature, e.g. our world. Halliday and Glaser (2011) use what they call “a working definition” which is: “a system composed of organized assemblages of humans and non-human life forms in a spatially determined geophysical setting” (p.2). They give the example of a farm where humans (the farmer) and non-
humans (plants, domestic and wild animals, insects, etc.) are organized in a way dictated by the farmer but completely dependent on the well-being of the natural system.

All social systems rely on an environmental resource base, ecological systems, in order to sustain life (MA, 2005; Walker and Salt, 2006). In practice this means that for humans to survive we need plants to turn carbon dioxide into oxygen, bees for pollination, healthy soil in which to grow our food, etc. The term social-ecological system indicates that the role of both natural sciences and social sciences are interlinked. According to Adger (2006) a social-ecological system implies that “human action and social structures are integral to nature and hence any distinction between social and natural systems is arbitrary” (p.267).

*Education for sustainable development (seeing the solution in democratic processes)*

The concept education for sustainable development is described by Sandell (2003) as a pluralistic approach, originating from fact based and normative traditions in environmental education. The fact based approach sees environmental problems as scientific knowledge problems, appearing as an unwanted consequence of society’s productivity and consumption of resources. Humans and nature are viewed as separate entities and solutions to secure productivity are found in research and information (Sandell, 2003). In the normative approach, the solution lies in influencing the environmental moral of human beings, since environmental problems relates to values and arise from conflict between society and laws of nature (Sandell, 2003). Education for sustainable development is about preparing the children of today for the challenges of tomorrow and improve their understanding of economic, social and environmental contexts (Siraj Blatchford et al., 2010). According to Sandell (2003), it is seeing the solution in democratic processes where all humans are looked upon as equally important in defining the values. The goal is to increase quality of life, including that of future generations (Sandell, 2003). UNESCO define it as an education that, in addition to teaching professional skills, learn students to “be resilient, become responsible citizens, adapt to change” as well as to “create a peaceful and sustainable society” ([http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-sustainable-development/](http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-sustainable-development/)).
Sustainable development (environmental, social and economic development)

For starters, it can be said that sustainable development is probably one of the most overused and misunderstood buzz phrases of our time, yet fundamental and critical to our future. A thesis alone would not do this subject justice, the following will therefore be the simplest of introductions. The Swedish government state that sustainable development involves the three areas of environmental, social and economic development, with the goal of all the being “in harmony and mutually reinforcing“ (http://www.sweden.gov.se/sb/d/2164). The most cited and widespread definition of sustainable development is that of the 1987 United Nations World Commission on Environment and Development’s document Our Common Future, also known as the Brundtland Report. The UN then defined it as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Chapter 2, 1.1). A slightly different definition by Amartya Sen (quoted in Siraj-Blatchford et al., 2010) is: "development that promotes the capabilities of present people without compromising capabilities of future generations"(p. 4). This is definitely a more encouraging worldview in comparison to one that focuses on the "needs" of people.

Resilience (how well systems cope with change)

Where sustainable development, as a term, dictates certain values and visions of what is deemed desirable, resilience is more of an approach, a way of perceiving system dynamics (Folke, 2006). In short, resilience is about how well systems cope with challenges without losing their main functions (Walker and salt, 2006). Carpenter et al. (2001) would add to this the capability of self-organization and the capacity to learn and adapt. Diversity is essential to building resilience, taking the shape of rich, elastic structures with multifold feedback loops (Meadows, 2008).

To further clarify the resilience concept, an example is how humans respond and recover from traumatic impacts. Positive examples of societal resilience would be New York City after the 9/11 terrorist attacks or Japan after the earthquake in 2011. Both societies had the infrastructure, the human capital and the faith to handle these crises. A less resilient example would be the drought on the Horn of Africa, where there are few back-up systems, unstable governments, rootless people
and a degraded environmental system. The vulnerability of such a system makes it much less capable of handling severe disturbances (Adger, 2006).

It should be noted, however, that resilience is not, in its nature positive. In contrast to sustainable development, resilience can also be undesirable (Carpenter et al., 2001; Walker and Salt, 2006). Arguably, it is because of the resilience of the current system, e.g. the fossil fuel economy that hinders sustainable development to be common practice.

*Systems thinking (asking what something is a part of)*

Walker (2004) emphasize that resilience relate to the dynamics of a system. A system is a product of the interaction of its parts and never the sum of its parts (Ackoff, 1974; Ackoff and Rovin, 2003). In general, systems thinking is about asking what something is a part of, instead of asking what parts it is made up of, and striving to understand the behavior of the containing whole. (Ackoff, 1974; Ackoff and Rovin, 2003). Systems thinking is about seeing trends over time, instead of focusing on individual events (Meadows, 2008). In particular, systems thinking is about seeing the relationship between structure and behavior. One way to do this is by identifying *elements*, *interconnections* and *function*:

*Elements* are the things, the what, or who that is part of the system.

*Interconnections* is how the elements are connected or held together, keeping in mind that everything is not connected to everything else.

*Function* (or *purpose*) is the why, that which explains the drive in the system.

All three categories are essential in a system, and they all interact (Meadows, 2008).

Meadows (2008) illustrate the thinking applied to a school: the elements are students, teachers, building, books, but also intangible things such as school pride and academic ranking. Interconnections are standards for admission, budget, gossip and transfer of knowledge. The purpose of the institution is to discover knowledge and pass it on.
Narrative (making stories)

The characteristics most notable for a story, or at least fairy tales, are the usage of: "Once upon a time..." together with "... and then they lived happily ever after". Simply put an introduction and an ending (Pramling, 1993). Bruner (2002) adds that another very common, but maybe less notable way of beginning a story is by “taking for granted the ordinariness or normality of a given state of things in the world “ (p. 6). According to Bruner (2000) narrative is a larger structure that provides an interpretive context for the components they encompass. Components in systems language would then be the elements and interconnections. Bar-Yam (2004) emphasizes our ability to describe something as essential to understanding it. According to him, one way of determining a system’s complexity is how many words you need, how long the story is, to describe the system.

Narratives also have the benefit of being ““real” or “imaginary” without loss of its power as a story” (Bruner, 2000, p. 44). Bruner (2000) claims that a really good narrative is not necessarily, or unlikely to be, pedagogical. Instead, it makes the familiar and the ordinary seem strange. In addition to this, he claims that the story is an invitation to problem finding (Bruner, 2002).

Finally,

Bruner (2000) says: “in understanding cultural phenomena, people do not deal with the world event by event or with text sentence by sentence. They frame events and sentences in larger structures, … These larger structures provide an interpretive context for the components they encompass” (p. 64). This relates to Meadows (2008) suggestion that instead of focusing on individual events, systems thinking is about seeing trends over time. Meadows further emphasize the benefits of drawing or writing down our mental models to become aware, and be able to modify, our view of the world. This approach will be practiced later, in the system maps of the meatballs p. x, x, and x.
3. Method

The thesis makes use of case study and narrative inquiry. As a study of contemporary experiences, Yin (1984) proposes the benefit of case studies. Narrative inquiry is a method where humans are seen as tale telling beings and the researcher create narratives out of the empirical material (Clandini and Connelly, 1990). According to Clandini and Connelly (1990) it is frequently used when investigating experiences relating to education.

3.1 Structural approach

The structural approach has been to simultaneously read, write and ponder, with occasional gaps of varied time. Arranging study visit included initiating contact with the preschools. The first one was a lead from the supervisor of this thesis and the other two from friends who work within child welfare. In line with ethical guidelines, this was followed by having parents approve the participation of their children with signed permissions that presented the aim of the study. Three mornings were spent filming and recording the visits, followed by additional hours of transcribing and analyzing the case studies. Writing and rewriting the thesis has to a large extent been about finding a rational flow of argument and fitting the pieces together.

3.2 Selection of method and motivation

The methods were selected based on the subject. The transdisciplinary nature of the study required a lot of readings in order to establish a basic overview of the different perspectives. Concerning the case studies, the motivation were to test if the narrative approach to systems thinking would work in practice and be able to evaluate results from real life interactions. A narrative inquiry was conducted, which enabled the making of stories out of the material collected. The original idea was to do one case study, but as the first visit provided limited data (and as it was such a delightful research method), two more studies were arranged.
3.3 Case study description

The case studies relate to three interview-dialogues with three groups of 5-6 year-old children, with five children in each group. Prior to each study, the children had been selected by their preschool teacher based on their communication abilities, imagination and good behavior. These requests were not explicitly put forward but were something all three teachers had taken into account. The children took part in the study voluntarily and with signed permission from their parents.

Each session started with an introduction stating that the researcher was from The Meatball Academy and wanted to learn as much as possible about meatballs. The reason for this visit was that it was known that these children were experts in the field. Together, they would now draw and tell the story about a meatball. There were paper and crayons on the table where everyone was sitting. Initially the children were asked if they liked meatballs and whether they would like to try one now. Frozen, ecological meatballs were then handed out and the questions began.

The purpose of the study was to collect answers to the following questions and by that be able to create a narrative of a meatball’s social-ecological system:

- What are the meatballs made of?
- Where does it come from?
- How does the stove become warm when you fry them?
- What happens when you eat one?
- What happens when you flush it down the toilet?
- What happens if you throw them in the trash can?

Each answer was then stretched as far as possible with several “And then what?” and “But, where does that come from?”

The conversations lasted on average for twenty minutes and were recorded by video and voice recorder. Each session was accompanied by an assistant who documented the study on film, either
with a real video camera or an iPad. The assistants were not professional filmmakers and different at each session: a researcher at the institution of Department of Mathematics and Science Education and two personal friends.

The aim of the case studies was not to judge what the children knew, or point out what they did not know. It was about bringing out whatever possible explanations to the meatball’s entry into the world and afterlife. The interviews were structured more as a conversation where questions were asked and the children would, together, tell a story and simultaneously draw the system surrounding the meatball.

3.4 Critical reflection of method

This thesis is about what narratives emerge around the meatball and whether the narrative approach is a beneficial one to systems thinking. Systems thinking is normally targeted towards complex systems. A critical reflection is thus whether the meatball really is a part of something complex, or simply a complicated system. In the setting of the case studies, the meatball might be too complex. Maybe a banana or an apple, something that is just a single unit and not multiple ingredients, would have been easier to grasp and given a more fruitful discussion.

The narrative inquiry is a subjective method for approaching the material as the researcher is a co-creating agent listening in on, and steering, a conversation. The stories were written based on the children’s input and with Bruner’s (2000) criteria taken into account, however, the researcher is the final author and ultimate creator of the meatball narratives.

A lack of pedagogical expertise in regards to young children might also have affected communication during the case study, and thus the outcome. During transcription, when it was possible to hear all the things they say at once, there are several situations where it would have been appropriate to ask them to elaborate more and pushed the questions even further. Someone savvier in this field could possibly have been better suited to conduct the study.
3.6 Critical reflection of data sources

The thesis includes several theoretical frame works and thus a brief overview of different concepts. Experts within each field are likely to perceive that some ideas are misrepresented. Information exists in abundance and it is problematic deciding, or knowing, what to chose and what to leave out.

At the last case study (“Panda meatballs”) the camera man failed to record the interaction. From this visit, only the voice recorded material has been used. In this case, and for the first time throughout the study, one of the children did not agree to give up his artwork to science. This was solved by photographing the images. However, the impact of these on the study and its final result is negligible.

3.6 Analytical framework

With the aim to investigate whether young children’s narration of an everyday object, the meatball, could be a beneficial approach to systems thinking and if something emerges that could be useful in education for sustainable development in early childhood education, the analytical framework is based on Bruner’s (2000) criteria for narration, Meadow’s (2008) tools for systems thinking and Walker and Salt’s (2006) way of making sense of the resilience concept. The common nominator between narration and systems thinking is framing things in a larger context, not word for word nor event for event, but a structure the ties it all together (Bruner, 2000; Meadows 2008).

Bruner’s (2000) criteria for narrative were used when writing down, and making sense, of the meatball case studies. According to Bruner (2000), narrative must fulfill four grammatical requirements; 1) Means for emphasizing human action directed toward goals controlled by agents. 2) Establishing and maintaining a sequential order - that events and states be “linearized” in a standard way. 3) A sensitivity to what is canonical and what violates canonicality in human interaction. 4) Something of a narrator’s perspective: it cannot be “voiceless “(p. 77).
In describing the collected material from a systems view, Meadows (2008) tools for mapping out system were used: 5) identify the parts (*elements*), 6) identify how the parts affect each other (*interconnections*) and 7) what the drive in the system is (*function*).

The discussion will later take into account Walker and Salt’s (2006) first concept to begin making sense of resilience: 8) to acknowledge that we exist within social-ecological systems and 9) that all of us live and operate in social systems that are inextricably linked with the ecological systems in which they are embedded.

Based on the above, the analytical framework is as follows:

- Creating, or being the voice of, a linear narrative with agents who keep with and break the convention. (1,2,3,4)

- Defining:
  What *elements* make out the narratives? (5)
  How are the elements *interconnected*? (6)
  What is the *function* of the different narratives? (7)

- Discussing briefly how the stories acknowledge, or renounce, that we exist within social-ecological systems. (8, 9)
4. Results

This section presents the results in regards to the research questions;

- What narratives emerge when young children talk about a meatball?
- In what ways do the narratives relate to systems thinking and a social-ecological resilience perspective?

The results are therefore fourfold:

- First, the story of a meatball’s entry and afterlife. The result from the narrative inquiry (Clandini & Connelly, 1990). By following Bruner’s criteria for narration, the conversations with the children have been turned into linear accounts of how a meatball could possibly come into and leave this world.
- Secondly, elements and interconnections graphically illustrated as a system map. This is done in accordance to Meadow’s (2008) suggestion to draw out or make maps of your systems, visualizing what is connected to what and how.
- Thirdly, a selection story elements, interconnections and functions presented in table form with emphasis on what drives the system (the function).
- Lastly, a discussion of what is canonical and what goes against the convention in terms of existing within social-ecological systems.
4.1. 1. The Story

*From the supermarket to nowhere*

Meatballs are food and brown. It is something that you buy. Meatballs come from the supermarket, ICA Maxi and Vivo. How they got there is unknown. They are made by “the people who work”, but also by parents. Meatballs are made of meatballs, or dough. A meatball has grown, like grass, from something and is now bigger. Things grow in soil. Meatballs can also be made of meat such as from humans, pigs and possibly a goat. When animals die, you take the meatballs from them. Cows have both milk and meatballs on their inside. There is also a high possibility that they have cows at ICA Maxi, and from them you get the meatballs.

You boil or fry meatballs and preferably eat them with macaroni and ketchup. The stove is activated by turning a knob. It becomes warm because there is smoke. Smoke comes from cigarettes and from the meatballs. You eat meatballs because you are hungry. Animals do not eat them, because they, unlike humans, cannot chew.
When you have had a meatball, it goes into your mouth, then further on to your tummy, before becoming brown, pee and poo. You flush it down the toilet where it goes down. It is unclear what happens to the poo. It simply disappears, but it is important to wash your hands afterwards. If you throw away a meatball you will tie the bag and put it in the trash can. The garbage then dies and start to smell bad. In addition, garbage can become soil and meatballs can be used as lipstick. And, there will be blood.

4.1. 2. System Map

*From the supermarket to nowhere*

System map 1. Data from the case study “From the supermarket to nowhere” presented as system map with elements and interconnections. Words are the elements and lines make out the interconnections. Question marks represent an “I don’t know” answer.
### 4.1.3. Table of elements, interconnections and functions

*From the supermarket to nowhere*

<table>
<thead>
<tr>
<th>Story 1. Element</th>
<th>Interconnection</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meatballs, animals, people</td>
<td>“made of meat such as from humans, pigs and possibly a goat.”</td>
<td>Producing and consuming meatballs. From what and by whom.</td>
</tr>
<tr>
<td></td>
<td>“made by “the people who work”, but also by parents”</td>
<td></td>
</tr>
<tr>
<td>Meatballs, supermarket</td>
<td>it’s something you buy.</td>
<td>Consuming meatballs.</td>
</tr>
<tr>
<td>Meatball, animals, cows</td>
<td>When animals die, you take the meatballs from them. Cows have both milk and meatballs on their inside.</td>
<td>The origin of meatballs.</td>
</tr>
<tr>
<td>Stove, smoke</td>
<td>The stove is activated by turning a knob. It becomes warm because there is smoke.</td>
<td>Heating the stove.</td>
</tr>
<tr>
<td>You, your tummy, pee and poo</td>
<td>it goes into your mouth, then further on to your tummy, before becoming brown, pee and poo</td>
<td>Digestion. How your body takes care of meatballs.</td>
</tr>
<tr>
<td>Poo, toilet</td>
<td>flush it down the toilet where it goes down</td>
<td>Make the meatball disappear.</td>
</tr>
<tr>
<td>Meatball, bag, trash can</td>
<td>Throw away a meatball, tie the bag and put it in the trash can. The garbage dies, start to smell bad.</td>
<td>Killing the garbage. Turning garbage into soil.</td>
</tr>
</tbody>
</table>

### 4.1.4. Canon and social-ecological systems

*From the supermarket to nowhere*

The only connection to nature in this story is the possibility that meatballs might come from animals and that garbage might turn into soil. Energy comes from cigarettes and animals reside at the supermarket. Poo is flushed down the toilet to be gone forever and trash slowly dies. The story shows very few signs of existing within social-ecological systems and the dependence of an ecologically sound resource base.
4. 2.1. The Story

*Electricity from the African sun and poo lakes with sharks*

Meatballs are obviously made of meat. Meat comes from animals and animals come from the stomach of the mama animal. Cows, sheep, lambs, kangaroos and pigs live on farms in the countryside, which can be in different places. The meat is taken in trucks to a factory where meatball machines get to work. The meatballs are then taken to the store where you buy them.
Mom, dad and grandpa are all capable of cooking meatballs on the stove. It is by pushing a button that the stove becomes warm. This is because there is a fire or a radiator below the stove. Or electricity. Electricity is something that comes from lamps and different countries. In Africa they have vast deserts and plenty of sunshine which makes things warm. That heat can be used for cooking meatballs.

After you’ve eaten a meatball it ends up in your tummy. There, the meatballs lie down and listen to your heartbeat. The meatballs are happy. From the stomach they are degraded to poo. Foxes eat poo, so do beetles, dogs and guinea pigs. All animals eat poo except hamsters. The poo goes down the toilet into the open sea. It sinks to the bottom of an ocean where you don’t go swimming. Or it might end up in a poo lake where only sharks live. From the toilet it can also go through tubes that takes it to the poo car. The poo car drives its freight to the poo house where the excrement then turns into soil. The underground tubes, that we cannot see, may as well take the poo to a factory where you make water. There they cleanse the water and remove the poo that in turn becomes soil.

If you throw away a meatball it goes to the dump in a garbage truck. Rats eat the trash, and birds eat trash too because they love human food. Another solution is to find a mountain where there is lava and then you can throw the trash down there. There are plenty of volcanoes on Iceland. Then the trash just burns down, disappears and the problem is solved.
System 2. Data from the case study Electricity from the African sun and poo lakes with sharks presented as systems maps with elements and interconnections. Words are the elements and lines make out the interconnections.
4.2.3. Table of elements, interconnections and functions

*Electricity from the African sun and poo lakes with sharks*

<table>
<thead>
<tr>
<th><strong>Story 2. Element</strong></th>
<th><strong>Interconnection</strong></th>
<th><strong>Function</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Animals, cow, sheep lamb, kangaroos, pigs</td>
<td><em>born from</em> mama animal, <em>live on</em> farms,</td>
<td>The origin of animals.</td>
</tr>
<tr>
<td>Meat, actory, meatball machines</td>
<td><em>taken in trucks to a factory</em></td>
<td>Producing meatballs.</td>
</tr>
<tr>
<td>Meatball, stove, fire, radiator, electricity, lamps, desert, sunshine, different countries, Africa, cooking</td>
<td>fire or a radiator <em>below</em> the stove, deserts and plenty of sunshine which <em>makes</em> things warm.</td>
<td>Generate heat to cook meatballs.</td>
</tr>
<tr>
<td>Meatball, tummy, heartbeat, poo</td>
<td><em>ends up in your tummy, lie down, listen to your heartbeat, degraded to</em> poo</td>
<td>Digestion. How your body takes care of meatballs.</td>
</tr>
<tr>
<td>Poo, open sea, poo lake, sharks</td>
<td>The poo <em>goes down</em> the toilet, <em>into</em> the open sea, <em>sinks</em> to the bottom of an ocean, <em>end up</em> in a poo lake where only sharks live</td>
<td>Make the meatball disappear.</td>
</tr>
<tr>
<td>Poo, poo car, factory, water</td>
<td><em>go through</em> tubes, the poo car <em>drives, remove</em> the poo</td>
<td>Make and cleanse water. Turning poo into soil.</td>
</tr>
<tr>
<td>Meatball, garbage, volcano</td>
<td><em>find</em> a mountain where there is lava, <em>throw</em> the trash down there, the trash just <em>burns down</em></td>
<td>Make trash disappear.</td>
</tr>
</tbody>
</table>

4.2.4. Canon and social-ecological systems

*Electricity from the African sun and poo lakes with sharks*

This story takes into account that we live in a globalized world, reaching far and wide across the planet. However, it not in a manner of “peaceful and sustainable society” (UNESCO) but a rather traditional approach to extracting resources from one place and discarding them in another place, preferably somewhere convenient like “an ocean where you don’t go swimming”.
4.3.1. The Story

*Panda meatballs and pasta butterflies*

When the meatballs are lying in the bag they talk with each other about poo and butterflies, macaroni butterflies in particular. Their chit chat concerns flying butterflies and brimstone butterflies. They are yellow, the same color as pasta butterflies.

Meatballs come from the store, but it is unclear how they got there in the first place. They are made of meat that comes from animals such as pandas, other bears and pigs. Animals live in the zoo. Meatballs taste good, but dinosaurs prefer to eat each other instead of meatballs. You use a frying pan and a stove to cook them, but it is unknown what exactly make it warm. You might also want to hang meatballs on your Christmas tree and then eat the whole tree.
If you throw away a meatball, it will be taken in a trash bag to a garbage dump. The people who work there then takes care of it. And if you run out of things you can go and look at the dump. When you have eaten a meatball it goes to your stomach. From there it becomes poo that you flush down the toilet. We don’t know where it goes from there, maybe nowhere. It clearly disappears and might end up on a poo dump that smells really bad. In rebellion, there is a dragon that eat meatballs and then takes a dump on the floor.
4.3.2 System map

*Panda meatballs and pasta butterflies*

System 3. Data from the case study *Panda meatballs and pasta butterflies* presented as systems maps with elements and interconnections. Words are the elements and lines make out the interconnections. Question marks represent an “I don’t know” answer.
4.3.3. Table of elements, interconnections and functions
_Panda meatballs and pasta butterflies_

<table>
<thead>
<tr>
<th>Story 3. Element</th>
<th>Interconnection</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>animals, panda, other bears, pigs, zoo</td>
<td>Animals <em>live in the zoo</em>.</td>
<td>The origin of animals</td>
</tr>
<tr>
<td>Meatballs, bag, store</td>
<td>the meatballs <em>are lying in the bag, come from the store, unclear how they got there</em></td>
<td>The origin of meatballs.</td>
</tr>
<tr>
<td>Meatball, trash bag, people, dump</td>
<td><em>throw away</em> a meatball, <em>taken</em> in a trash bag to a garbage dump, where people <em>takes care</em> of it</td>
<td>Taking care of trash.</td>
</tr>
<tr>
<td>Meatball, stomach, poo</td>
<td>it goes to your stomach, it becomes poo</td>
<td>Digestion. How your body takes care of meatballs.</td>
</tr>
<tr>
<td>Poo, toilet, poo dump</td>
<td>flush down the toilet, it goes... maybe nowhere, might end up on a poo dump</td>
<td>Make poo disappear.</td>
</tr>
</tbody>
</table>

4.3.4 Canon and social-ecological systems
_Panda meatballs and pasta butterflies_

This is the story told with most imagination. Dinosaurs, edible Christmas trees and indoor dragons are all out of the ordinary. In regards to a social-ecological system there are no connections made to nature. Animals live at the zoo, and the only piece of an ecological system seem to be the butterfly in the minds of the conversing meatballs.
5. Discussion

The following discussion is linking back to the thesis’ aim to investigate how young children’s narration of a meatball is a beneficial approach to systems thinking and if what emerges could be useful in education for sustainable development in early childhood education. I will highlight aspects of the children’s stories that could be worth taking into account when planning activities in regards to learning for sustainable development. Education for sustainable development is about preparing for future challenges and understanding environmental, social and economic contexts (Siraj Blatchford et al., 2010). It is about teaching resilience, adaptation, responsible citizenry for a peaceful society (UNESCO).

Humans as separated from nature

It is interesting to see the lack of significant human activity in the children’s narratives (besides cooking and “working”), especially as it is the human activities of the last 50 years that greatly has altered the planet’s ecosystems (MA, 2005). The stories include mostly technology (machines, factories) and other animals who are in charge of the action. I would like to call this a Disney-fication of reality. There are few connection to “real nature”. A farm and the countryside appear in one story, a desert to get energy from and an ocean or lake that functions as a sink for human excrement. Humans are clearly separated from nature.

Out of the wall citizens

In regards to sustainable development, none of the stories are promoting the harmonious relationship between social, economic and environmental dimensions, nor do they take future generations, needs or capabilities regardless, into account. The pedagogy of place (Duhn, 2009) is interesting here as one example basically state that meatballs come from the supermarket and disappear in the toilet, and another one ventures as far out in the world as Iceland in the North and
the African continent in the South. This is also the only sign of a global perspective, as emphasized by Pearson and Degotardi (2009). Alas, not in accordance with education for sustainable development values. This leads to the possibility that the idea of learning for sustainable development is dominated by grand words and great intentions (Sandell, 2003, Siraj-Blatchford et al.; 2010, UNESCO, 2012) although a long way from being implemented. Linking back to the problem statements, the children confirm the current lack of a holistic perspective and are clearly citizen in an out of the wall society (Sandell, 2003).

Soil and poo

Soil play a great part in explaining both what happens to trash and to poo. It might even be possible to make meatballs from it. Soil is the only component that suggest some closed loops in these systems. Other than that, there are not many signs of Walker’s and Salt’s (2006) concept definition of: “We all live and operate in social systems that are inextricably linked with the ecological systems in which they are embedded” (p.31). From a resilience perspective the diversity of the systems varied from, in the case of poo; no solution, to one solution to multiple solutions. A where meatballs come from the supermarket and disappear in the toilet is not resilient. A system with several ways of providing food and to take care of excrement is more so.

Acknowledging uncertainty

Two of the groups retorted to “I don’t know” several times, whereas the other one were not satisfied until they found a solution, more often than not, imaginary. But the acknowledgment of uncertainty could also be a winning trait in these children. My first idea was to bring out stories from their imagination, but the fact that they say "We don't know" might be even a greater gain for living in our world. Still, an "I don't know" is even more valuable if it is followed by a "but I think.." och "but I'll try to find out". “I don’t know” remaining as ignorance, or an “I don’t know” as an key to knowledge seeking.
Eating animals

A more disturbing finding is the lacking connection between animals and meat, or what type of animals humans eat. Although this is not an explicit campaign to reduce the children’s meat consumption or turn them into vegetarians, from a social ecological point of view, creating a change in eating choices would have a significant impact. If more kids were aware that meatballs really comes from animals it is possible that they would be less inclined to eat them.

Play and participation

The meatball study had the ambition to make the serious nature of food production, energy, waste and sewage treatment, somewhat more amusing. It has succeeded in this from a grown-up perspective, but it is unknown what the children thought of the story making and whether they consider this to be playing. Good participation leads back to the fact that everyone has a role in the system, instead of following one leader. The stories were created in groups, although the input from individual children varied greatly.

Systems telling

Bar-Yam’s (2004) theory on the relationship between a system’s complexity and the number of words to describe it is debatable, since all three stories are more or less the same length, but the systems map have great differences in both amounts and variety of elements and interconnections. The amount of elements is an indicator of each system’s resilience, as a richer and more elastic structure leads to greater capacity to handle disturbances. Relating back to Bruner (2000) it is also interesting to see that the better the story, the less pedagogical. The more correct, the less intriguing story. Yet, it is problematic if the children continue to think that this is the way things work. Further input or action is needed after the drawing out the system and writing the stories. Where the study ended, is actually the beginning, to continue the approach to research with and by children, as suggest by Barratt Hacking et. al. (2012).
Follow up and give back

In this case, the way of thinking around an everyday object is meant to instill a curiosity to ask the same questions about other things. This change does not happen overnight, or after one meatball interaction, but it would certainly be improved if we were to draw and tell our worldview more often. It would be interesting to follow up the case studies to see if there has been any actual impact, as Bowker’s (2007) research show that children can learn a lot during a dynamic workshop. I would also argue that a “give-back” to the children remains, that is to say that they should get a reward for their input and something to remind them of the meatball’s system. This could be e.g. either a storybook, as the research of Bigger and Webb (2010) suggest the educational potential for environmental narratives, a diploma, a collage or the like.

6. Conclusion

This thesis put forward the argument that storytelling is a beneficial approach to systems thinking in early childhood education. The reason for this is twofold. Firstly, in regards to the resilience framework (Walker and Salt, 2006), it is a creative way to acknowledge that we are all part of an interconnected system, if only on a very basic level. Secondly, it confirms the notion of narrative as a swell tool to find problems (Bruner, 2002). By asking certain questions in regards to the meatball, narration be seen as a easy-going key that unlocks education for sustainable development. The deeper goal is to turn systems thinking into systems telling, to make up your own stories, and thus make meaning of the surrounding world. The adventures or misadventures of the meatball stories are then invitations to find out more about the issues of food production, energy, waste treatment, and so on, either with a teacher or a parent. Systems telling can thus be used to move towards a world of responsibility, caring and fascination for the complexities around us and our role within it. Alas, every meatball can be a change agent.
7. References


Nationalencyklopedin. (n.d.) Definition of meatballs (köttbullar). Retrieved from http://www.ne.se/k%C3%B6ttbullar


*Appendices (Upon request)*

1. Form of approval for participation, as signed by the parents. (Medverkan i studie för föräldrars godkännande.)
2. Transcript of case study dialogues.