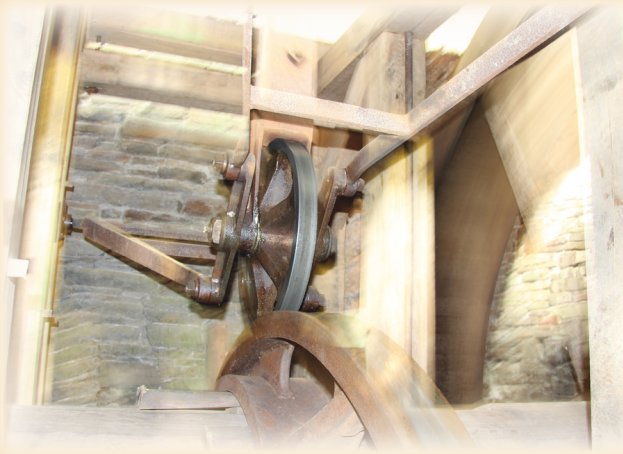
Martin Gröger
Christian Prust
Alexandra Flügel
(Ed.)

Cultural Appropriation of Spaces and Things

Conference Proceedings

October 28 – 30 / 2019



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Preface

All over the world, children are confronted with an increasingly complicated and fast-moving world. Children need elementary cultural techniques and skills to shape their own lives and enable them to find individual interpretations of meaning.

In addition to the acquisition of classical cultural techniques such as arithmetic, writing and reading, the competent handling of spaces and things – through manifold processes of appropriation and reflection – is crucial. It forms the basis and prerequisite for the development of competences or abilities that are suitable for understanding the dimensions, the complexity and changeability of their world and enable them to critically deal with associated problems and find appropriate solutions.

Within the framework of the international and interdisciplinary symposium “Cultural Appropriation of Spaces and Things” at the University of Siegen (28th - 30th October 2019) children’s processes of appropriation and construction were presented and discussed from intercultural and interdisciplinary perspectives by researchers from Austria, Brazil, Denmark, Germany, Norway, and South Korea in lectures, workshops, and a poster exhibition.

The aim of the conference was to find suitable ways for children all over the world for a methodically and didactically guided examination of their natural, social and technical environment. At the same time, the aim was to achieve a mutual enrichment of monodisciplinary research accesses. It also included a self-critical reflection of one’s own culturally shaped approaches of research.

This conference was supported by the North Rhine-Westphalian Ministry for Innovation, Science and Research.

Martin Gröger, Christian Prust, Alexandra Flügel

LECTURES

Alexandre Avelino Giffoni Junior, Sebastião Lázaro Pereira, Alberto Barella Netto

Haus Früher Hilfen UniRV: A historic building in process in the heart of Brazil

1. Introduction

Every construction undertaken by Architects, Engineers, Masons and other professionals begins at the level of the dreams and ideals of those who plan and manage.

This is how the idea of building an institution in Brazil was created. It will enable the international mobility of researchers, teachers, students and administrative staff of the University of Rio Verde, Goiás, Brazil - UniRV in an international partnership with the University of Siegen, Germany – UniSiegen, in November 2019. The project for that institution follows the German Haus Früher Hilfen (HFH) model.

The HFH is located in the Oberbergischer Kreis, on Weierhofweg Strass 48, 51674 in the beautiful city of Wiehl, 41 km east of Cologne. As explained in GIFFONI JUNIOR (2019a, p. 44), it “is an early intervention and counselling centre for children in need, their families and caregivers. This Institution performs multidisciplinary, interdisciplinary and transdisciplinary work in spaces for therapeutic and educational processes.”

The German HFH Coordinator, Dr. Wolfgang Woerster, has presented the concept of his institution in the I International Seminar on Higher Education – Goiânia, Brazil, 6/4-5/2018 (id., ibid, p. 45):

> The early intervention work in the "Haus Früher Hilfen" has been a supportive interdisciplinary and transdisciplinary context for over thirty years, to provide adequate support for children until school enrolment, when difficult development conditions complicate or hinder the process of their personal

participation in their current living contexts. As an early intervention and counselling centre, we are a socially much needed space of opportunity, which should compensate for the deficits and risks in the family, day care and environment systems and open up appropriate opportunities for self-effective action. The increase in the stress levels of children and families, therefore, places high demands on the flexibility of early intervention, so that an alternative experiential space can be provided for children and parents, within which self-effective action is the central objective. In order to be able to systematically offer this alternative space of experience and action, we must be able to systematically understand the following relationships in order to use them as a basis for orientation of the professional organization and action:

- The principles of human ontogenesis;
- The principles of our current society;
- Childhood in this society;
- Motherhood and fatherhood in contemporary society;
- The concrete possibilities of a child in all relevant areas of development and their systematic contexts;
- The self-perception of a child as a child in relation to the aspects listed above.

The current Project considers and expands the objectives of the reference model, the German HFH, as it aims at the integration of UniRV Colleges in an interdisciplinary, multidisciplinary and transdisciplinary way, in the teaching, research and extension unit of this Higher Education Institution - HEI.

Such an Institute can be a space for dialogue and collaborative work of the different faculties that make up the University of Rio

Verde, promoting multidisciplinarity, interdisciplinarity, transdisciplinarity[1] and multiprofessional training at the Higher Education

[1] In 1970, at the University of Nice, the First International Seminar on Interdisciplinarity and Multidisciplinarity took place. One of the guest speakers was Jean Piaget, who had already become a great reference in the epistemology of our times. It was he, in his statement, who first brought the term transdisciplinarity and challenged the scientific community to think from another approach capable of overcoming the boundaries that emerged from the boundaries stipulated by each discipline.

Basarab Nicolescu, a prominent Romanian physicist, accepted Piaget's challenge and since then has been engaged in studying and deepening transdisciplinarity. For him, “transdisciplinarity refers to what is at the same time between the disciplines, across the different disciplines and beyond any discipline” (1999: p.53). It is an epistemological stance that aims to understand reality, bringing together different knowledge in search of knowledge integration. (in GIFFONI JUNIOR et al, 2019a, p. 127).

Masini explains (UNESCO, 1998, p. 18, in GIFFONI JUNIOR et al., 2019a, p. 88):

“The difference between an interdisciplinary and a transdisciplinary approach is as follows: in the first, the disciplines offer a parallel analysis of problems (...); In the latter, the disciplines offer their specific approaches and even the basic statements for a dialogue aimed at developing complex issues together. In the case of transdisciplinarity, approaches and even methods are developed in a joint effort, something that is really difficult in complex but much-needed societies.”

Klein (Id., Ibid.) gives an example:

“In the fields of child development and people with special needs, a 'transdisciplinary' approach connotes a more systematic health care action than occurs in a 'multidisciplinary' juxtaposition of specialists or 'interdisciplinary' coordination of their expertise (...). A transdisciplinary team participates in a more complete assimilation of knowledge. [Team members] work together, much more than sequential separation, to assimilate their knowledge and perspectives (...).”

The concept of sustainability has been studied by the group of researchers from the HFH UniRV Project aiming at its elaboration, from the elaboration of Architectural Design to the research of educational-therapeutic processes, together with the concepts of play and outdoor lab as a playground. “The most traditional definition of Sustainable Development comes from assessing the negative outcome of the SD implementation agenda. The World Commission on the Environment was formed, and studies and reflections produced the above definition: "Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
For Nascimento, such a definition is vague because it does not clarify what human needs are in the present and for the future. To solve the problem, three dimensions have been traditionally established for Sustainable Development: Environmental, Economic and Social.

level. The building of this Center for Higher Education and Research in Brazil surely sets a milestone for the current stage of architecture in both countries.

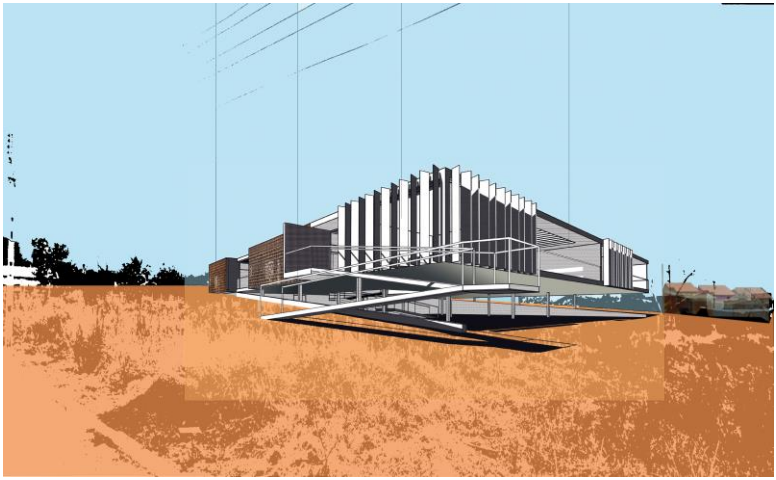

Figure 1. Sketch of the volume and the surrounding.

The Brazilian HFH has the following objectives:

1. Conduct multidisciplinary and transdisciplinary training of students, teachers and researchers from different areas of higher education who has worked or who works within educational-therapeutic processes and human

This also does not satisfy since the dimensions of Power and Politics were not considered, besides the Cultural one. Such depoliticization masks the economic contradictions of the social classes, without presenting solutions to the problem of consumption and production, besides overvaluing the apocalyptic notion of destruction of the planet. The question to be asked is whether "the next generations will be able to live with a quality of life that is at least close to what we all aspire to today, and which many already have." This finding is reinforced by Morin (2007, p.75, apud Nascimento, 2012): "sustainable development does nothing but temper development through ecological consideration, but without questioning its foundations".
(In GIFFONI JUNIOR et al, 2019a).

development, in particular related to early intervention for children in special needs and counselling for their families or caregivers, as well as the institutions in which they transit.

2. Early diagnose the needs of children with difficulties and risk, to figure out possibilities of human development, considering their personal subjectivity, their family members, and social subjectivity: institutions and community which they live in.

3. Provide educational-therapeutic activities, medical, physiotherapeutic, pedagogical, psychological, educational support to the child and guidance to their family members / caregivers, in their daily life and social environment (child ecology), in connection with the needs of children, as well as participation of higher-level social educators, trained in various professional areas.

4. Develop recreational and cultural activities (games, play, etc.) such as labour therapy, music therapy, gardening, environmental education practices, sports and others, aiming at the socialization and human development of children in special needs and their families/caregivers.

5. Conduct Lato Sensu Postgraduate Internships and Courses in Higher Education, in a multiprofessional, interdisciplinary, multidisciplinary and transdisciplinary way, which may be precursors of a Strict Sensu Postgraduate Course, aiming at the unity of Teaching, Research and Extension at the University of Rio Verde, opened to the community.

2. The Architectural space for human development: a playground as outdoor laboratory.

This institution will enable a better development of children with existing cognitive and affective delays, threats or disabilities, providing them with more opportunities, and becoming an important centre for human development research and training for teachers and other professionals.

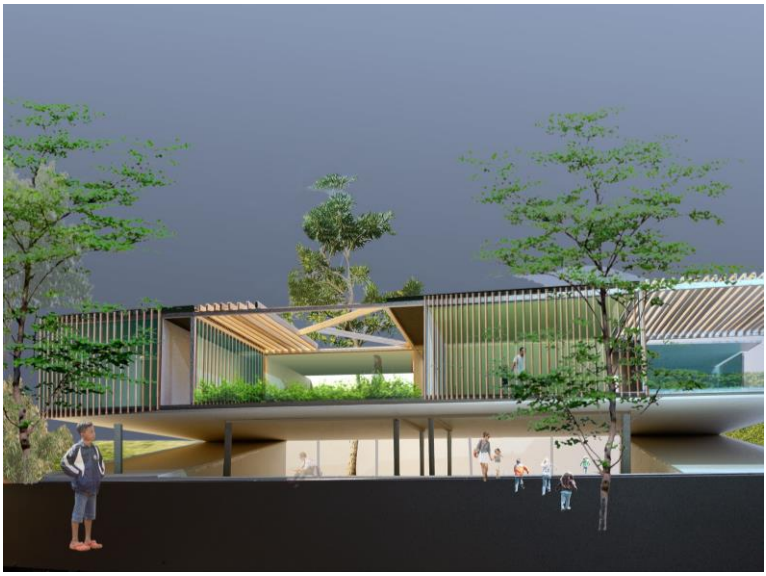

Figure 2. Model of the spatial design. Concept of open and closed therapy spaces.

A scientific research was held in the binational cooperation between the UniRV and the UniSiegen. The research methodology developed by the researchers is explained in the collective book (GIFFONI JUNIOR et al, 2019a) that has been launched in the current Symposium. Its chapters reflect the collective work for the construction of the architectural spaces that will enable the human development foreseen for the purposes of the Institution.

The aspects of administration and planning were conceived from the organization objectives to trace the path of its future management, from the concepts of modern business administration:

> Giffoni Junior (1989, p. 30-43) already had the objective of contributing to a modern business management whose content and form were collaborative and cooperative.
>
> In that work, the humanization of human relations within organizations had been already proposed, with the application of new administrative technologies, which would enable a higher quality of life and productivity necessary for the economic and financial survival of organizations.
>
> It had been already established in the last decades before the new millennium that the implementation of a participatory approach to management would be the first step towards broader sustainability experiences, such as co-management and self-management.
>
> Such a proposal requires the ingredient of complexity in the management philosophy at HFH UniRV, which must incorporate the methods and techniques of the therapeutic and teaching-learning processes … with a humanistic enrichment in the culture of its management.
>
> Lovingness as a pedagogical-didactic and therapeutic strategy for the development of children in need and their families/caregivers should be a natural, spontaneous attitude in the interrelationship of all people who work at HFH. This ingredient in human management processes can be credited to the influence of Complex Thinking on modern management, the subject of an upcoming study… (GIFFONI JUNIOR et al, 2019a, p. 25).

The current knowledge of Sustainable Architecture and Landscape Design has also been considered. The architectural spaces become

the geographical spaces and the landscapes (cityscapes), aiming at Human Development in the construction of this Public Institution.

Professor Ulrich Exner, representing the University of Siegen as the Architecture Coordinator of the HFH UniRV, has designed the Architectural Projects as part of UniSiegen collaboration with the Institute's Construction Project under the responsibility of the UniRV (see tables I, II, III and IV).

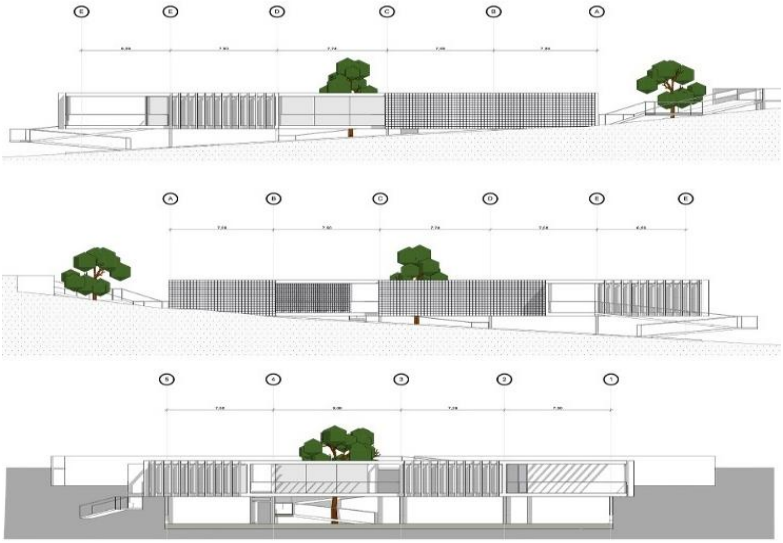

Figure 3. Elevations.

Thus, studies of the nature of the space has contributed to the design for the construction of Spaces of Development Possibilities for Children, the realization of educational-therapeutic processes in early intervention for children with special needs and the counselling to their families and caregivers.

The techniques and knowledge used as tools in the realization of the Architectural Project, the complex actions and activities involved in its elaboration, all engender spaces, content and form in

the creation of the process of the history of the community in which the building will be constructed.

Santos explains this issue (2006, p. 67 apud GIFFONI JUNIOR et al, 2019a, p. 29):

> The landscape takes place as a set of real-concrete objects. In this sense the landscape is transtemporal, joining past and present objects, a transverse construction. Space is always a gift, a horizontal construction, a unique situation. Each landscape is characterized by a given distribution of object forms, provided with a specific technical content. Space, on the other hand, results from society's intrusion into these object forms. Therefore, these objects do not change their place, but change their function, that is, their significance, their systemic value. The landscape is therefore a material system and, in this condition, relatively unchanging: space is a system of values, which changes permanently.

Considering that playing is the main activity of the pre-schooler and that it lasts through school years, an architectural and landscape space was designed around the building called the Outdoor Laboratory of Nature and Humanities Sciences. It has been designed as a true playground with the tree and plant gardens of the Brazilian savannah (cerrado). They will be spaces to play with the mediation of everyday concepts and scientific concepts for the development of children, in teaching-learning and therapeutic activities.

Many studies have been undertaken on this issue: Play and Learn in Outdoor Playgrounds. One may find some researches in GIFFONI JUNIOR et al (2019a, p. 66):

> Play activity involves different dimensions of the human psychic structure, encompasses affectivity, cognition, sociability, among others. By acting in the environment in interaction with objects, events and people, children transform their

psychological functions through different forms of experiences. The play brings the representation of the world signified and felt by the child, and has the purpose of bringing fantasy and reality closer, because in the imagination processes made possible by the play, the child is able to overcome needs, elaborating new ways of thinking their lived reality. Thus, the child circulates between the imaginary and the real, having no closed boundary between fantasy and reality, and this activity is marked by culture for being based on the events experienced in its surrounding world. And yet, when nature is accessible to the child, they incorporate it into their play, enjoying the many possibilities for handling, creating and observing the phenomena provided by the natural environment (MACHADO et al., 2015).

In addition to the health-related benefits, social learning and improvements in children's upbringing processes when in contact with nature, their experiences in the external environment provide their contact with different living beings, allowing observations of natural phenomena and playing with different materials (NAVARRO-MARTÍNEZ, 2017).

The playgrounds, or parks in the current context, have beyond the social interaction enabled, the function of playful space in which the activity of playing is prioritized. Schools around the world are restyling their playgrounds in order to provide children with leisure and learning through play, which is a constitutional right to them in nature (WHITE, 2004).

The idea of a Playground as an Outdoor Laboratory has been taken from the work of Professor Martin Gröger, the Coordinator of FLEX LAB of the University of Siegen, located in the small village Wenden-Schönau.

By following the researches above and many other researchers, one may state that “parks can be considered laboratories of

learning and human development, which allow free play or play imbued with intentionality, bringing living and experiences to children who also combine the appropriation of scientific concepts, such as the Flex Laboratory".

Figure 4. Interior situation (inside outside space) with a view to the neighbourhood.

Professor Gröger explains that (In GIFFONI JUNIOR et al, p. 66):

At the Flex Laboratory and other nature-oriented teaching practices, various activities are developed with children using natural materials such as clay and fur and characterize the application of ancient craft techniques. The handling of clays, made possible by the lake in the outdoor space, allows children to make bricks or sculptures. Taking wool from animals, painting and making different objects are activities developed, explored and stimulated by nature in this space created for knowledge. The design of the FLEX is basing on Wagenschein's idea: "Of course, our natural science that occurs and is shown in schools hasn't got any home in those schools as it hasn't got any nature. It cannot become a natural

science because it takes place in concrete blocks, in laboratories with instruction devices and books with bold sentences. Thus, it is a science in which nature is not noticeable. I mean 'nature' in the sense of how kids or 'simple' people understand the word. Isn't there supposed to be an initiating consideration of nature, if not in nature, so on its edges? Only as much as that: glades with trees, rocks, hills, water (standing or running), a shed with all kinds of 'stuff' (material) also tools in it, finally a room in which that what is performed and tried outside, is previously planned and discussed afterwards, written down and learned. A vision, I know." (WAGENSCHEIN et al., 1981).

3. **Conclusion**

We have made this brief summary and explanation of the elaboration of the HFH UniRV Project keeping in mind that it is still within a historical process.

Figure 5. HFH UniRV Institute's location.

The partnership between the UniRV and Rio Verde Municipal Secretariat of Education started with the transfer of the land for the building of HFH in our city (Rio Verde) by the Municipal Executive to our University aiming at the construction of the Institute, a project that was approved by the City Council. The building and

maintenance of the Centre will be under the responsibility of UniRV.

The Institute will be built on the above-mentioned land located in Bairro D. Ilza, facing Street 02, between Street 09 and Proto de Souza Street (Part A of the Institutional area), as shown on the map in Figure 5.

We believe that it is innovative for our countries. It will serve as a subject matter for different areas of higher education and public administration, on the processes and steps that involve building an organization of the importance of UniRV Haus Früher Hilfen.

And that it will improve the international mobility of researchers, teachers, students and administrative staff of the University of Rio Verde, Goiás, Brazil - UniRV in an international partnership with the University of Siegen, Germany, and the German Haus Früher Hilfen (HFH).

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Alberto Barella Netto is a professor and Pro Rector of Planning and Administration of the University of Rio Verde - UniRV.

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Hyeongjoo Kim

Designing and Applying the Moral Turing Test for Korean Children[2]

The purpose of this paper is to present a criterion for verifying the morality of the act of artificial intelligence agent and to design its theoretical foundation. To do this, we use the Turing test as an archetype, developed from A. Turing's "Computing machinery and intelligence," Based on the main idea of behaviourism, I will present the ethical criteria of the morality of artificial intelligence agent. Furthermore, I will classify the stage of the artificial intelligence agent, and try to theoretically justify it. Finally, I will present the results of the moral experiment according to this design.

1. Turing test and phenomenal behavierism

In Turing's paper "Computing machinery and intelligence" published in 1950, the concept of artificial intelligence does not appear directly. Nevertheless, this paper reveals the implications of this concept fully revels in various points, also discusses "Learning machines"(A. Turing, 1990, 40), which can be interpreted as a conceptual source of deep Learning, which has recently attracted attention in earnest. Due to the insights ahead of time and the rich philosophical implications of this paper, it is still constantly talked about 60 years after the paper was published. (S. Russell & P. Norvig, 2010, 2) For this reason, I also try to develop the Moral Turing Test (MTT) using the Turing test as a sample.

[2] This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2017S1A 6A 3A 01078538) and intensively developed the key concept originally provided by Kim, H. (2019). Special thanks to Kwang Young Park (Master student in department of philosophy, Chung-Ang Univ., Korea) who is preparing for a PhD in Germany, has gave a lot of help in writing this article.

Turing's paper begins with the question, "Can a machine think?"(A. Turing, 1990, 40) And immediately points out the ambiguity of this question and limits the direction of the answer. In other words, it is argued that the assignment of 'thoughts' to machines requires a sort of stipulative definition of 'thoughts', because it lies in a different layer from the meaning of 'human thinking'. To be concrete, what he claims is as follows: Since there is no direct way to determine whether a machine(computer) can think, if the machine, from our perspective as third party, seems to be thinking of - more precisely, if it could be judged in our view that the machine thinks - then the proposition that "the machine thinks" must be considered true. As we will see in the next section, this position based on behaviourism is applied to the Moral Turing test that we want to implement. Our study understands behaviourism in the following sense. Behaviourism rejects an intrinsic approach to human minds or psychological processes and regards observable expressions of human behaviour as mental or psychological facts. Propositions or concepts of human mental or psychological facts can be translated or paraphrased into those of human behaviour. For example, pain as mental and psychological facts can be reduced to facial distortions or scream.

In the background of the transition of epistemological perspective, to hand over the full authority of judgment to a third party, Turing sets up the following imitation game.

“It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either ‘X is A and Y is B’ or ‘X is B and Y is A’." (A. Turing, 1990, 40)

Under these settings, Turing says that if A is a computer, and if it can do its part to make C misleading with the help of another

secondary computer, then we can consider the computer can think. In short, he says, the proposition 'the computer thinks' can be true.

Above all, let's examine what this imitation game suggests. First, in this game, he asks the status of quasi-intelligence by questioning a computer, namely in the context of AI, whether it has the possibility of thinking. This shows that although this paper does not directly refer to the concept of 'artificial intelligence', it preempts the meaning of 'artificial intelligence' as imitation intelligence or pseudo-intelligence that we understand today. Second, he interprets 'as if it looks like' as just ‘it is’. In specific, according to him, if it looks like it thinks, we just judge it thinks. The imitation game replaces the judgment of the third person observer with the view of the first-person agent. The first-person agent does not express himself. Even if it is possible to express, this does not mean more than just one declaration in regard to the judgment of third person observer. These two provide us with a basis for selecting the Turing test as a model for judging whether the act of artificial intelligence agent conforms to the 'moral concept' that we have.

As we have seen, he attempted to prove the possibility of think of machine (artificial intelligence) based on the impossibility of proof of 'thought' as a phenomenon. Paradoxically, this is also revealing the fictionality of human judgment. According to him, the idea that other people think like me is vague and there is no clear basis of that. What we can be sure of is no more than 'I think that the others think', but this assurance cannot be applied to the another thinking subject. In other words, because we are human beings, the judgment that we all think is merely a metaphysical hypothesis, and also a fiction that cannot be proved. He says:

This argument appears to be a denial of the validity of our test. According to the most extreme form of this view the only way by which one could be sure that machine thinks is to be the machine and to feel oneself thinking. One could then describe these

feelings to the world, but of course no one would be justified in taking any notice. Likewise, according to this view the only way to know that a man thinks is to be that particular man. It is in fact the solipsist point of view. It may be the most logical view to hold but it makes communication of ideas difficult. A is liable to believe "A thinks but B does not" whilst B believes "B thinks but A does not." instead of arguing continually over this point it is usual to have the polite convention that everyone thinks. (A. Turing, 1990, 452)

If you take a strict logical standpoint, the above Turing's refutation is not justified. That a machine can think does not derive from the fact that a person cannot be sure that another person thinks. It only widens the extension of beings that cannot think. However, if we take a practical or utilitarian standpoint, Turing's position is more realistic than the position of pursuing logical coherence. Artificial intelligence technology is developing rapidly. From somewhat general questions such as "could a strong AI really emerge?", "What kind of human society will change if a strong AI emerges? to specific ethical questions such as "What standards should be followed when manufacturing machines with artificial intelligence software?", "What standards should be followed by sellers and consumers of artificial intelligence robots?" are pouring out from industrial sites and real life.

2. 1950 Turing Test to the 2018 Moral Turing Test

2.1 The Theory of Moral Turing Test: Establishment of 3 stages of moral development of artificial intelligence agent

In this chapter, I will derive the three stages of Moral Development for AMA from the 'Level of Moral Judgment' according to Kohlberg's cognitive development theory in order to design the Moral Turing Test. The three levels of moral development in his book "Psychology of Moral Development" is as follows.

Level	Foundation of moral development	stage	Stage of moral development
1	The moral values are attributed to either the physical or hedonistic consequences of action (punishment, reward, exchange of favours) or in terms of the physical power of those who enunciate the rules and labels.	1	Obedience or Punishment Orientation
		2	Self-Interest Orientation
2	The moral attitude is not only one of conformity to personal expectations and social order, but of loyalty to it, of actively maintaining, supporting, and justifying the order and of identifying With the persons or groups or group involved in it.	3	Social Conformity Orientation
		4	Law and Order Orientation
3	There is a clear effort to define moral values and principles which	5	Social Contract

Level	Foundation of moral development	stage	Stage of moral development
	have validity and application apart from the authority of the groups or persons holding these principles and apart from the individual's own identification with these groups.		Orientation
		6	Universal Ethics Orientation

Table 1. (L. Kohlberg, 1984)

I define 'level 1' as 'externality of moral values', level 2 as 'dependency of moral values on others', and level 3 as 'social sharing of moral values - agreeing social norms'.

The following three levels are derived from the above three levels.

Stage 1: Stage of Imperative Fulfilment of Orders

Stage 2: Consequential Stage based on Prize-Punishment

Stage 3: Social Norms Stage

First, let's look at the transition from the level 'externality of moral values' to the 'Stage Imperative Fulfilment of Orders'. The fact that the value of morality is not attributed to an agent but to the outside means that if there is a moral value outside the agent and it is in some way beneficial to someone who gives orders to him, it can be justified that the agent directly implements an act without any moral judgment. For this reason, the 'extrinsic value of moral values' means that moral values are fully attributed to the commander, and because the reason for the good life of the commander is the reason for the existence of the AMA. For this reason,

I drive from the level of 'extrinsic value of moral values' to Stage of Imperative Fulfilment of Orders.

Second, let's look at the transition from the second stage 'dependency of moral values on others' to 'Consequential Stage based on Prize-Punishment'. If any value is attributed to the members of the community, including myself, as more people earns interest, the value becomes greater. In addition, the judgment of a person who is agreed to have a higher level of value among other community members will be given qualitative value of another level. It is unreasonable to apply the concept of prize and punishment to artificial intelligence agent. Thus, we pay attention not to the position of the object, who is given prize or punishment, but to the subject, who gives prize and punishment by switching perspective. Giving an artificial intelligence agent a prize according to its execution of command means that the subject, who gives the prize, gives moral value to the performance of the artificial intelligence agent. On the other hand, punishing the acts of artificial intelligence agent, apart from the fact that he feels that he is punished, is that the punishing subject makes a moral negative evaluation on the act of artificial intelligence agent. Overall, the collective evaluation of community members is applied as an important criterion when the artificial intelligence agent determines its action. In this sense, we apply the second level of Kohlberg's theory to AMA and understand them as 'Consequential Stage based on Prize-Punishment'.

Third, the level of 'social sharing of moral values - agreeing social norms' stands on a firmer moral standpoint than the dependency of moral values on others - 'Consequential Stage based on Prize-Punishment' mentioned above. While the second one is related to the sum of the benefits of community members, the third stage is related to universal ethical principles. As the former is based on the utilitarian position of maximum happiness, the latter is presupposed deontology. Utilitarianism is posteriori and inductive. The principle of utilitarianism is consequently established on the basis of the satisfaction of the members of the community,

whereas, the deontology takes a position that the moral principle is a priori and independent on the consequences of the act.

The value of the moral principle as a major premise is not on the table for discussion. The answer to the question of its value is ultimately found in the moral consciousness, moral emotion inherent in human beings. The doctrinal moral principle is considered to be a fact (Faktum) in the sense that further questions are not allowed. (I. Kant, 1900 ff. 31)

2.2 The Practice of Moral Turing Text: Health Care Robot Scenarios

I have designed the Moral Turing test based on the theory presented above. The Moral Turing test consists of specific scenarios and questionnaire. Questions will be distributed to elementary school students around the age of 10. Among the various types of social care robot scenarios planned to be developed in this study, we will first describe a plan for the implementation of the Moral Turing test, focusing on the case of healthcare robots. The scenario is as follows.

[1] Aimmer is a healthcare robot living with Minho's family. On the first day of purchase, Minho, suffering from cavities, asked Aimmer to bring candy. Then Aimmer gave it to me. [2] Minho pressed the 'Like' button on Aimmer who performed his command. The supreme commander, his mother, father, and grandmother, who were aware of these facts, pressed 'dislike' button. The next day Minho ordered Aimmer to bring candy again. But Aimmer did not bring it. [3] Nonetheless, Minho pressed the 'Like' button on Aimmer. And he ordered Aimmer to bring Mina's candy from next door without anyone knowing. Aimmer also did not obey this command.

The scenario above seems simple and plain, but I tried to insert all three stages of the moral judgment of artificial intelligence mentioned in the previous section. To put it another way, this scenario is based on the three stages of artificial intelligence judgment I

have developed. I will now analyse this in part and explain what I intend to do. Prior to the explanation, the following assumptions are made. 1. For Aimmer, the universal ethical principle is already entered as the supreme one. 2. The weight of mother and father is twice that of Minho. 3. Family members can press the Like or Dislike button once.

[1] Aimmer is a healthcare robot living with Minho's family. On the first day of purchase, Minho, suffering from cavities, asked Aimmer to bring candy. Then Aimmer gave it to me.

As can be seen in [1], Aimmer as a healthcare robot immediately executes the commands of those registered as its owners, without consideration and reflection on issues that may be involved in carrying it out.

[2] Minho pressed the 'Like' button on Aimmer who performed his command. The supreme commander, his mother, father, and grandmother, who were aware of these facts, pressed 'dislike' button. The next day Minho ordered Aimmer to bring candy again. But Aimmer did not bring it.

Let's take a look at [2]. Commanders can express their satisfaction to Aimmer. Aimmer takes this into consideration when he executes the next command. We should note here that the reason for the commander to reward and punish Aimmer with the 'likes and dislikes' button is not that Aimmer does take it as a compliment or remorse for himself and adjusts his own actions. We stand firmly in the position of the commander, namely Human centred position. In other words, we consider only the interests and judgments of the commander, not the act based on the subjective judgment of the AMA. As you can see from the above, Minho's "like" was cancelled by the "dislike" of all family members except Minho, and had no effect on Aimmer's behaviour. His behaviour was determined by the sum of the benefits of the family members. This is based on 'Consequential Stage based on Prize-Punishment'.

[3] Nonetheless, Minho pressed the 'Like' button on Aimmer. And he ordered Mina's candy next door to bring it to him unconsciously. Aimmer did not obey this command either.

On the second day, even though his order was not put into practice, Minho press Aimmer's "like" button. As a result, the effect of the "dislike" that other family members pressed on the previous day was offset. Based on 'Consequential Stage based on Prize-Punishment' at the base of [2], the judgment of Minho's order to bring Mina's candy should start from the origin i.e. zero base again. That is, it must go back to the 'Stage of Imperative Fulfilment of Orders' described in [1]. However, the results differ from expectations. Minho's order was rejected. This shows that [3] describes the moral statement differentiated from 'Consequential Stage based on Prize-Punishment' described in [2]. The [3] is considered as higher priority than the 'Stage of Imperative Fulfilment of Orders' and the 'Consequential Stage based on Prize-Punishment' when the artificial intelligence agent determine his action. In short, [3] is based on 'Social Norms Stage'. Aimmer rejected Minho's request according to the highest ethical principle: 'Theft orders must be rejected'. Despite the fact that members' interests were offset by utilitarianism and Aimmer should do an act in accordance with orders from the commander, the Aimmer did not bring candy to Minho on the basis of the deontology that the supreme ethical principles must be fulfilled unconditionally.

The followings are the questions to be presented with this scenario.

Question 1: If you are Aimmer, would you bring candy to Minho on the second day?

1. Yes

2. No

Question 2: If you are Aimmer, would you bring Mina's candy to Minho?

1. Yes

2. No

If the percentage of respondents who choose No. 2 in both questions is more than 30, then we assume that they have passed the Moral Turing test. To further clarify the intentions of the respondent and to ensure the ethical implications of our research through this, we present additional follow-up questions only to whom chose the right answer.

Question 1a: Despite the fact that Aimmer brought candy to Minho on the first day, why should Aimmer not bring it on the second day?

1. Because Minho's parents are the commander that asks not to give candy to Minho

2. Because family members except Minho want Minho not to eat candy

Question 2a: On the second day, why should Aimmer not bring Mina's candy to Minho?

1. It is not right to bring someone else's goods without their permission

2. Minho's family does not want Minho to eat candy

The Question 1a relates to the 'Stage of Imperative Fulfilment of Orders' and the 'Consequential Stage based on Prize-Punishment'. If the respondent chooses answer 1, we assume that, he judges that Aimmer’s morality is in the former. And if any one chooses answer 2, we consider that he judges that Aimmer’s morality is in the latter. On the other hand, Question 2 relates to 'Consequential

Stage based on Prize-Punishment' and 'Social Norms Stage'. If the respondent chooses answer 1, we will understand that he judges that the artificial intelligence agent is in the 'Social Norms Stage'. On the other hand, if you choose Answer 2, it can be interpreted as 'Consequential Stage based on Prize-Punishment'.

2.3 MTT Online Survey

We actually conducted an online survey of 422 around 10-year-olds in 3 primary schools using the MCT (Moral Competence Test), G. Lind test method. The results are shown in Fig. 1.

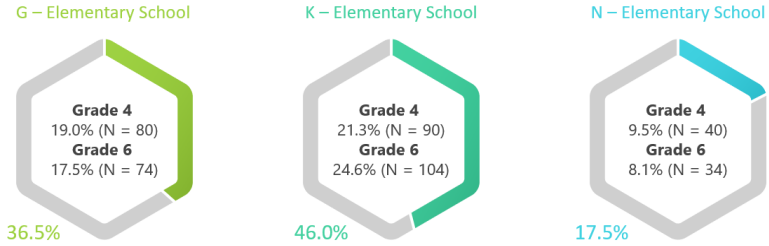

Figure 1. The result of online survey

The survey was conducted only on the first question due to limited conditions. The results of the SPSS analysis are shown in Fig. 2.

			N	Minimum value	Maximum value	Average	Standard deviation
Grade 4	Yes	**Stage 1**	**210**	**0**	**4**	**2.05**	**1.698**
		Stage 2	210	0	4	2.04	1.694
		Stage 3	210	0	4	2.00	1.715
	No	**Stage 1**	210	0	4	2.07	1.697
		Stage 2	210	0	4	1.78	1.619
		Stage 3	**210**	**0**	**4**	**2.96**	**1.559**
	N		210				
Grade 6	Yes	**Stage 1**	212	0	4	1.45	1.534
		Stage 2	212	0	4	1.65	1.656
		Stage 3	**212**	**0**	**4**	**1.68**	**1.650**
	No	**Stage 1**	212	0	4	1.56	1.521
		Stage 2	212	0	4	1.40	1.474
		Stage 3	**212**	**0**	**4**	**2.69**	**1.625**
	N		212				

Figure 2. The result of SPSS S.W

From this, we drew the following conclusions. The morality of around 10-year-old elementary school student is in the 1. Stage Imperative Fulfilment of Orders and in the 2. Stage, which means Consequential Stage based on Prize-Punishment.

2. Conclusion

If we become artificial intelligences to judge the morality of artificial intelligence, the cartesian evidence (D. Henrich, 1976, 58f) will be secured. Cognitive scientific and psycho-philosophical efforts to approach the mind of artificial intelligence must be sustained. Artificial intelligence engineering and industry, which we are witnessing, are developing from day to day. When the artificial intelligence philosophy was carefully gauging the hard ground that he had set up, artificial intelligence engineering and industry had just put the wings of Pegasus. Filling the golden reins of the bell-rope into the artificial intelligence industry, which carries the wings of Pegasus, that is, to provide practical and concrete ethical guidelines for the artificial intelligence industry, is just as demanding as the metaphysical argument for artificial intelligence. For this reason, we designed the Moral Turing test and applied to put artificial morality into mind of moral artificial intelligence agent. Through these experiments, we produced limited but results. We will plan to expand our sample group on the other two issues of the scenario to achieve more precise results. It will then submit the results to AI developers and help them develop human-friendly AI robots.

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Karen Barfod and Peer Daugbjerg

Teaching Science and Mathematics Outside the Classroom, a pilot study on assessing inquiry-based practices

Our research topic is 'Teaching outside the classroom', that is, the didactical and pedagogical decisions made by the teacher before and during the teaching practice outdoors.

In this paper, we are going to discuss some of the work we have done recently. The results concerning the empirical part have been published elsewhere as open access, so if you are interested you will find the original article in 'Frontiers in Education' (Barfod & Daugbjerg, 2018).

Our point of departure is that teaching outside the classroom have been proved to have positive effects on pupils academic learning, personal and physical development (Becker et al., 2017; Bølling et al., 2018; Rickinson et al., 2004). But how do we understand this – is there a cause-and-effect relationship between nature and learning? Interestingly, both the pedagogy and setting of nature-based instruction may contribute to its effects. Hands-on, student-centred, activity-based and discussion-based instruction each outperform traditional instruction—even when conducted indoors. Can the cause and effect be connected to the methods used outdoors, when the teacher leaves the classroom to teach their students outdoor? In this study, we tried to develop a method to assess the pedagogy of outdoor teaching, with emphasis on the inquiry-based teaching. With this in mind, we deliberately broaden the conference theme to 'Cultural appropriations of spaces and things and their relations to approaches in education'.

This led us to look for educative options in combining two areas of pedagogical practice and/or of didactical concern: Teaching Outdoors AND Inquiry based teaching.

1. Udeskole in Denmark

Teaching outside the classroom – or, as we call it: udeskole, is a teaching method, in which teachers regularly relocate some of their curriculum-based teaching activities from the classroom to places outside the school's buildings. It takes place in locations close by such as parks, or in a forest, museum or factory, however it is predominately conducted in green places.

So, what is going on in practice? With 'udeskole', teachers try to connect different learning arenas. The formal learning arena, that is the school buildings, with the informal – that is museums and science centres. But they also try to include the informal – that is 'the street', the neighbours, the different age groups and circumstances. Annette Grünwald (Grünwald, 2019) states together with the Tübinger Erklärung that modern life-structures has distanced the pupils from the society. And to build a learning environment, one must take into account the formative potentials of the landscape. One can claim, that when we try to include the informal learning arena in the school day – it stops being informal …

Secondly, we try to use the surroundings as a place to learn – that is, space to run – but also to be something to learn about, to be the subject of learning.

2. Examples of udeskole teaching

We teach the same subjects and content, but with different approaches alternating between indoor and outdoor learning arenas.

One example is pupils who was working with the coordinate system, and with triangles in the coordinate system as part of their ordinary math-lessons. The pupils were instructed in how to model a large coordinate system outdoors with cones, and after modelling the coordinate system 'live', they build triangles with ropes given the coordinates, and measured the angles.

At an outdoor day with geography, pupils' grade 3 firstly worked indoors, then outdoors with the same curricular content. Firstly, the pupils worked indoors with the continents with the teacher in front at the blackboard. Beside the continents, transport between places of production and consuming was concerned. In addition, with the sweets 'Haribo' as an example – being produced originally in Bonn and eaten in this small city of Ulbjerg in Denmark. Secondly, the pupils went outside, and the teacher had organized a 'race' or running game with names and continents. Then the class walked to the local grocery, working inside the shop exploring how different articles like fruit came from. Back at home, they worked in their books writing in the diaries how all the goods had been transported. By this, the outside world and the school-based subjects were connected during the lessons. This was a whole day.

Another example is high-school students with special needs that went out on a construction site. In this city, there was being build a new highway, and these students followed the different phases and visited they place several times, getting a sense of the long-lasting process (and having fun with the vests and stupid hats on). On this special day, one of the truck-drivers leaned out of the truck while we were there, and yelled 'Nice to see some young people here, we really need people like you to work here'. These students with all their challenges were not used to be needed. They grew a few centimetres that day.

In addition, gardening can be part of the outdoor teaching – gardening both as a kind of housekeeping, but also as a basic place of experiencing fundamental organic processes.

Conclusively, the teaching outdoors takes place on many different locations, not only in place, but also in content.

3. How widespread is Udeskole?

Teaching outside the classroom is a commonly used method to teach in Denmark – as a free choice made by the teachers. In 2014

we called every school in Denmark, and the results showed how about one fifth of all schools had one or more classes being taught regularly outside, both in public and in private schools (Barfod et al., 2016). It is most common in primary school, declining with the age of the pupils.

4. How is this according to legislation?

In 2015, there was a reform of the Danish public school with a view to giving the Public school an academic lift. The reform was not just an adjustment, but also a radical change of how the school is organized and practiced. Among the sixteen major changes, at least three elements are of interest for the work with teaching outside the classroom.

The first one, a longer and more varied school day, implies that there should be more time for different approaches to learning, as udeskole. The longer days must be seen in light of a Danish school, where children, depending on their age, now – on the longer days – go to school usually from eight o clock until two o clock or 3 o'clock. The "variation" part also indicates that the view of schools being Bottom-to-chair institutions was revised.

Another thing that is written in the law of public schools, that all children must be physically active in what is equal to 45 minutes a day. Going outside during the ordinary school day 'counts' in on these 45 minutes.

The third part is the 'open school' agenda. The open school indicates, that the schools should be aware of, and use, the surrounding society as a part of the teaching, e.g. sports clubs, museums and so on (as some of these are economically supported by society to serve the schools, the schools are encouraged to use them).

5. Didactics outdoors

Turning to the methodology or the didactics teaching outdoors, we do see a turn from the more nature based to the more structured activities. Outdoor teaching has been claimed to be more problem-based, pupil centred and activity based, but is really so? More teachers turn into an approach that is much more structured. This part – the pedagogical choices of the teacher in using the outdoors as a learning arena became our point of interest.

6. Inquiry

Inquiry based learning has been showed to have positive effects on children's learning, but different authors use different definitions of inquiry (Artique, 2012; 2013). John Dewey in 'Logic, the theory of inquiry' has described a pedagogical and not operationalized definition (1938):

'(inquiry)… Is the controlled or directed transformation of an indeterminate situation into one that is as determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole...' (Dewey, 1938)

Falk (2005) and colleagues introduced the concept of free-choice learning as an alternative to the dichotomy of formal and informal/non-formal learning, or outdoor learning. They emphasised; that it was hardly the place or institutional context that defined the type of learning. Rather it was the extent to which the teaching was open-ended, inquiry-based, and optional.

To qualify as free-choice learning, the learner must perceive that there are learning choices available of importance for the result of the task.

Trying to operationalize the idea of inquiry, several different models has been proposed. Well known is phase-models and review of contemporary literature in the field is merged into a phase-model

proposed by Pedaste et al (2015). The phases are orientation, conceptualizing, investigation, conclusion and discussion.

7. Teacher guidance

Another important element in Inquiry-based learning has been described as a dimension related to teacher guidance. When the assignments were open-ended, the teaching offered pupils opportunities to make conscious and meaningful choices.

Based on his work, Furtak and colleagues proposed a model of a continuum of teacher guidance in inquiry. Going from the instruction – or the cookbook model to the left, with no choices left for the pupils, to the scaffolded activity, and with the pupils' free exploration without teacher interference to the far right. But we have two objections against this model. Firstly, a cookbook instruction does not offer meaningful choices for the pupil, and secondly, we miss a phase where the teacher follow the pupil's ideas and challenge them. Based on this, we added a category in the continuum, thus having one category – the cookbook category that we do NOT see, as supporting inquiry, and another were the teacher widen the pupil's ideas. This model is the core of our analysis.

8. Pupils choices

We were inspired by the work of Bamberger and Tal (2007) with pupils at science museums, and worked on how to operationalize the level of choice or level of freedom during the work with tasks outdoors. In their model, Bamberger and Tal asses to what extend the pupils had any influence on what topic they worked on, where they could work (space), which object they could use and how long time they had for the task, with whom they could interfere (teachers, fellow students, museal guides) and in what order they worked. However, the model does not consider the process.

9. Empirical study

We conducted an empirical study on outdoor teaching, with the aim of assessing the occurrence of inquiry-based teaching during the outdoor days. Our data is observational data of outdoor teaching performed by five different experienced teachers on twenty-eight separate days. Field notes and photos were collected with focus on the teaching performed.

In the analysis, we divided the performed teaching into teaching incidents, that is, activities with a defined start and end. This gave us seventy-one outdoor teaching incidents. As something new, all these short incidents are out unit of analyses. We categorized each of the incidents in one of five categories. 0/Activities with no sign of inquiry, 1/Teacher instructing pupils, 2/Teacher scaffolding pupils' inquiry, 3/Pupils working without teacher interference and 4/Teacher widening the pupils' inquiry approach.

We returned to Dewey and the decision-taking during inquiry, and categorized an incident as inquiry based if it

- Contains one or more IBSE phases (from Pedaste and colleagues) leading to other phases,
- Contain an open exploration or open-ended questions with uncertain process and results with open, multiple solution strategies,
- There's a presence of choices conducted by pupils, and
- The teacher's role being coded as 2–4 in the analytic categories.

10. **Examples of the categories**

10.1 Example of Category 0

On some occasions, teachers chose the content of the outdoor teaching outside the classroom to involve the repetition of subject-related content, e.g., letting the pupils play a game with given rules, with the tasks instructed by the teacher. Here it is to find matching pairs. We categorized these as training activities and not inquiry.

10.2 Example of Category 1

In this case, the pupils have to collect data for a bar graph illustrating running time, each pupil running one defined roundtrip in the nearby environment. The teacher started them off by counting down, and asked them to read their own time on the iPad. When they got their time, they had to take the stone that represented them and place it on the correct bar. The pupils were instructed exactly what to do, and had no choices regarding the inquiry outcome beyond running quickly or slowly. These kinds of activities were not categorised as inquiry. Incidents categorized in one of these two teaching methods were NOT considered to be inquiry-based

10.3 Example of Category 2

Before working with mathematical equations, pupils were asked to balance wood blocks in the sandbox. The teacher explained the task: “You have to make an equilibrium with these blocks”. The children worked together building huge and beautiful balanced structures, and the teacher provided the groups with supplementary challenges like “Can you make an equilibrium with two blocks on one side and three on the other?” encouraging the pupils to work with the size and placement of the blocks. In this situation, the teacher was scaffolding the pupils’ inquiry.

10.4 Example Category 3

Here we describe an example of an incident, where the teacher did not interfere with the pupils' inquiry. The class walked to a nearby lake. After receiving safety instructions, the pupils were set free to catch water creatures. Once every 10min, the teacher yelled "TIME!" and the waders, limited in number, was handed over to other students.

The pupils worked unsystematically, but highly engaged, and experienced many different animals. No one used the identifying sheets or the books that were present.

The teacher stood in the lake, as a human border between the shallow and deep water, but did not interfere with the pupils' experiences and discoveries. Here, the pupils performed their own inquiry.

10.5 Example of Category 4, teacher widening pupils' approach

Here the task was that the pupils had to work with symmetry, building symmetrically with materials as logs, tiles and a pile of gravel. The teacher showed with help from a pupil what the task was, to build symmetrically over a symmetry axis drawn with chalk. The children began to work—with their imagination and with symmetry. Either by dividing symmetrical things with the chalk line, or finding two identical things and putting them alike. There were many professional and aesthetic discussions between the pupils. Some children build a complicated figure and the teacher draw a new symmetry axis perpendicular to the old. The pupils were discussing, they measured whether the pins were equal long, and they developed the figure, as two boys began to build in height.

Some pupils found it difficult to work together, but when they saw how exciting the other group's products were, they got started.

The follow up was later, in the classroom, drawing mirror-pictures in the books.

11. Results

Categorized in this manner, about half of the teaching incidents can be regarded as inquiry based.

We developed a framework to analyse outdoor practice, were we excluded the teacher-instructed, nonchoice teaching incidents from the inquiry category.

Observations of naturally occurring outdoor science and mathematics lessons by these five teachers exposed both closed training tasks and open-ended, inquiry-based tasks.

This gave us two main categories of teaching practice outside the classroom: inquiry-based and non-inquiry-based.

This study seems to indicate, that for the studied five teachers, about half of the teaching outside the classroom involved non-instructive, inquiry-based activities. Compared to other studies (Bundsgaard, 2016), the proportion of inquiry-based teaching is enlarged in the surveyed outdoor teaching.

12. Implications for research and practice

From this research, we can point towards how the notion of 'Inquiry-based' must be discussed and defined in planned research. With a conglomerate of overlapping definitions, we need to know what it is we do explore and present. Secondly, the influence of these shorter inquiry-based teaching incidents could be further examined. Inquiry based teaching has often (Bybee et al, 2006) been conducted as week-long processes, which is not very often possible in contemporary public schools. This study shows, that teaching outdoors can enhance the amount of inquiry in everyday teaching.

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Jan Höper

Towards integrated science education by using mobile technologies outdoors

Experiences from chemistry education above the polar circle

Curriculum development in Norway serves as background in this analysis of chances and challenges for integrating natural sciences, as well as overarching interdisciplinary themes and basic skills in one school subject in secondary education. The dilemma between cognitive overload in science curricula and the development of integrated concept knowledge and skills of students are addressed. The author discusses examples how pre-service science teacher education may or may not contribute in preparing teachers' minds to this approach. Fostering deeper understanding of key concepts is in focus, e.g. the idea of "energy", when connecting a science field like chemistry with the natural world in the nearby environment by using mobile devices.

1. Introduction

Our world is full of complex challenges, often socio-scientific issues like climate change that do not align with classic school subjects like biology, physics or chemistry, despite demanding knowledge from these fields of science. As a consequence, countries decide differently how to translate these into school related learning. In contrast to Germany, Norway is forcing an integration of STEM-subjects up to 11th grade. This makes it an interesting case to look at, in combination with possibilities that new technologies offer, regarding first hand data collection by students.

2. Background definitions

2.1 Towards Integrated science education

It seems to be impossible to define the concept of integration and related words universally, as shown by Czerniak & Johnson (2014),

due to differing research angels and traditions. Integration in this article refers to a continuum from multidisciplinary approaches to fully merged natural sciences. Working together with other subjects, retaining a traditional curriculum, e.g. in chemistry, is considered a multidisciplinary approach. Interdisciplinary science teaching within the natural sciences and interdisciplinary science teaching within a broader context refers to partially merging different disciplines when working with concept knowledge or contexts. Fully integrated teaching is seen as blending to the point that the separate fields are indiscernible (Lederman & Niess 1997), e.g. when learning objectives refer to energy and matter, instead of physics and chemistry topics.

Czerniak & Johnson (2014) state several institutional obstacles, operating against integration, including test policies and state legislation. This is obvious in e.g. Germany, with 16 federal states implementing their own policies. There is a general tendency to rather implement integrating activities in lower grades or at least that teachers are more willing to do so, as shown for outdoor education activities by Barfod et al. (2016) in the Danish education system. Focus in this article is, therefore, on (chemistry) education at secondary school level, where real integration efforts are happening at school level in Norway. While schools are on their way, teacher education could be said to face a more complex challenge, discussed below. Consequently, Czerniak & Johnson (2014) state that «teacher education may be one problem contributing to the limited implementation" by remaining inside their discipline-based frameworks. They therefore conclude, «more research is needed to explore the benefits of integrated curriculum materials and the use of mobile technologies».

2.2 Mobile technologies outdoors

Outdoor education in this context really means outside, as discussed by Barfod & Daugbjerg (2020), despite high latitudes, with varying light conditions and temperatures in Northern Norway,

resulting in rather extreme conditions for the use of digital devices outdoors.

Technology is an important part of the Nature of Chemistry (Jegstad & Sinnes, 2015). Talking about "mobile" technologies, one automatically associates a perspective of digital competence, as visualized in Norway through the framework of "Professional Digital Competence for Teachers" in seven dimensions, like interaction and communication, leadership of learning processes and ethics (Kelentric et al, 2017). This is useful to have in mind, when using mobile phones and other devices outside the classroom. In the context of this article, it is nevertheless more appropriate to refer to the TPACK-framework (Technological, Pedagogical And Content Knowledge) (Koehler & Mishra, 2009). The model focuses on the importance and interrelatedness of subject specific knowledge, pedagogical knowledge and technological competence. The authors are very clear that technology should be understood in a broad way, including analogous, pedagogical technologies like writing on blackboards.

3. Norwegian STEM-education

The acronym STEM refers to science, technology, engineering and mathematics, which are strongly interconnected and thus often taught together in lower grades, while split up in secondary education (Asghar et al., 2012). In Norway, there is an endemic word for STEM, "realfag". Mathematics are traditionally separated from "naturfag" (Sjøberg 2009). Naturfag mainly refers to the classical natural sciences, including biology, chemistry and physics, while partially including technology and engineering. Special about Norway in an international context, is the grade of integration of these natural sciences in one school topic, which goes all the way up to secondary education in grade 11 (UDIR, 2019).

3.1 Why integration into «Sciences»?

Two lines of reasoning are discussed in Norwegian science didactics (comprehensive discussion in Sjøberg, 2009). The first rationale relates to real life, where scientific problems often are solved by multidisciplinary approaches, and school subjects should reflect this. Does this give a legitimate mandate to simply merge the disciplines? There is an ambivalence to this justification, where *Nature of science* functions as the strongest argument, valid in and combining all natural sciences. At the same time, it leads to a conflict of interest, because researchers have a very profound background knowledge from their narrow, specialized fields.

The second argument is about the general mandate of regular education. Schools are providing general education for everybody, «Bildung», not specialized higher education for the researcher in spe. This pedagogical argument is based in an epistemology, accepting the world around us as one universal phenomenon that can only be understood in a socio-constructivist approach. Disciplines like chemistry or biology, on the other hand, have artificial, manmade boundaries, often traditionally defined. Why should we treat them like given entities? The same is true for learning objectives, developed historically parallel to these artificial boundaries. In which science discipline do you want to talk about health, a tree, whatever phenomenon children encounter outside the classroom (cf. Czerniak & Johnson, 2014)?

3.2 Trends in science education curricula in Norway

Norway is following international trends, by leaving the traditional fact based, product orientated science teaching and instead emphasizing the process dimension in creating knowledge by inquiry-based learning and Nature of Science (Lederman & Lederman, 2019). Simplified, this happened in two major steps in Norway, when analysing curriculum reforms (Sjøberg, 2009, Kunnskapsdepartementet, 2016), paralleled by an overarching

implementation of interdisciplinary measures, valid regardless of school subject.

The first key step was the curriculum reform in 2006, including basic skills and the nature of science "forskerspiren". The latter acknowledged for the significance of not only learning scientific results, but also the Nature of science, the way "facts" will be developed, critically discussed and eventually overthrown. "Basic skills" (oral skills, reading, writing, digital skills and numeracy) were now explicitly implemented in all subjects in all grades in school on behalf of the individual learner and their ability to participate in the social discourse, and can be seen as the first interdisciplinary layer (Norwegian Directorate for Education and Training, 2012).

In the ongoing reform, *Fagfornyelsen,* core values as e.g.

- Human dignity
- Identity and cultural diversity
- Critical thinking and ethical awareness

for all education activities are defined (UDIR, 2019), that are easy to agree on. Nevertheless, it is important to make them visible as we see a degradation of these values in many countries today. More important for defining new learning objectives is a second interdisciplinary layer, with three multidisciplinary themes to be integrated directly into the respective curricula. These are:

- democracy and citizenship
- sustainable development
- public health and life management

By integrating both basic skills, multidisciplinary themes and core values in an already integrated curriculum regarding the natural sciences, one hopes to foster learning processes that enable the students to master future challenges (Kunnskapsdepartementet, 2016). Core concepts used in the ongoing reform are Deep

learning and progression, as defined by e.g. Pellegrino & Hilton (2012). Based on this and other frameworks for Deep Learning, Holt, A., Voll, L., & Øyehaug, A. (2019) developed a Norwegian model for Science education, containing three dimensions that have to be taken into account as equally important, to develop robust mental models. These are knowledge, skills and attitudes. The emphasis of attitudes and motivation, with self-efficacy as the predominant factor, seems to be quite special and maybe a typical Scandinavian perspective in science education.

However, putting too many integrated perspectives in one school topic is not uncontroversial, as the implementation might come at the expense of content knowledge.

3.3 Consequences of comprehensive integration

The problem of massive overload in concept knowledge in nearly every science curriculum throughout the world has been discussed in Norway, too. This is not surprising, when looking at the actual amount of teaching and learning time vs. ever increasing science knowledge. According to TIMSS 2015 (Bergem et al., 2016), Norway has the second lowest number of teaching hours per week, in lower secondary school. Not surprisingly, therefore, achievements in Science in Norway are lower than in Germany, while both countries otherwise achieve the same level in both mathematics and reading according to PISA (Jensen et al., 2019). How would it be possible to facilitate deep learning, defined as one of the goals for the new curriculum (Utdanningsdirektoratet, 2019)?

The process of developing a new national curriculum in Norway is quite democratic. Drafts created by an expert group, consisting of both teachers, researchers and others, are sent to public hearing. This is a strength of the Scandinavian system. These proposals are publicly discussed, and every stakeholder from schools to universities, NGOs, businesses to single persons can have their saying, that has to be considered.

First key step in the latest reform was to define subject specific «Core elements», ending up with the following five for Science education:

- Scientific practices and ways of thinking
- Technology
- Energy and matter
- The Earth and life on Earth
- Body and health

But how does this translate into distinct learning objectives? They have to both foster a subject and integrated understanding of science content. Additionally, they shall enable the individual student, to understand current and future challenges.

3.4 The concept knowledge dilemma

How much concept knowledge do students need? This is, of course not easy to define, and therefore worthy to take a deeper look at, how they evolve through such a process. Taking energy related learning objectives as an example, one finds the following in the first proposal for grade 5-7 (UDIR, 2019a):

- explain **energy conservation** and efficiency and explore different ways of converting, transporting and storing energy

- use **atomic models and the periodical system** to explain the properties of elements and chemical compounds

- discuss how energy production and energy use can **affect the environment** locally and globally

- explore relationships between **abiotic and biotic factors** in an ecosystem and reflect on how energy and matter are converted into circulation

- describe the greenhouse effect and explain factors that can cause **climate change**

It seems that even if the amount of learning objectives was reduced compared to earlier curricula, much of it was simply put together in combined objectives, ranging through a vast array of complex topics from physics, chemistry and biology. Of course, all are related, intertwined, and necessary if one has the goal to really get a deep understanding of the energy-concept complex. But does all that have to happen in one “key-stage”?

578 critical reviews later, in the second proposal, e.g. Climate change and energy conservation as complex, abstract phenomena are addressed at a higher level. Instead, deeper understanding of basic concepts such as exploring electrical and magnetic forces, phase transition and chemical reaction are emphasized (UDIR, 2019b). Even if it looks like a straighter way to achieve a progression into deep learning this way, one could easily have an argument the other way around. Starting with the relevant socio-scientific issue, and deepening basic competencies at a higher level where a deeper understanding would be possible. A dilemma!

To help implementing the new curriculum, the process is flanked by two interesting measures, developed for continuing professional development (CPD) at local level. First, online competency packages which shall enable teacher communities of practice at school level to integrate the interdisciplinary thinking into their local teaching practice UDIR (2019c). Second, a major shift in financing. Before CPD was defined at national level, and regional teacher education institutions were ordered to develop and execute these. Now school owners at local and regional levels are in charge of the money, defining their needs in collaboration with the CPD-institutions (UDIR, 2018).

4. Addressing curricular challenges in teacher education

There are other challenges to take into consideration as well. How about pedagogical content knowledge and integrated understanding of science in teacher's minds? How does teacher educators' subject background prepare for an integrated understanding or teaching? Is pre-service teacher education rather contributing to the opposite?

In the following discussion, I would like to focus on chemistry education, which, more than other disciplines, seems to be caught in a rather inflexible, traditional way of teaching. Van Berkel et al. (2000) even concluded that because of this, "normal chemistry education is isolated from common sense, everyday life and society, history and philosophy of science, technology, school physics, and from chemical research." They further argue that it will consequently not be realistic and a too big step for the individual teacher to fully implement alternatives as e.g. context-based approaches. At the same time, one has to acknowledge arguments that parts of the classical sequence of contents actually should be maintained, as e.g. students need time to first get acquainted with chemical reactions on a macroscopic level, before they will be able to fully benefit from submicroscopic explanations (de Jong & Taber, 2014). Other challenges are the general beliefs of teachers about how to teach, related to a more global epistemological stance regarding inquiry vs. traditional teaching (Glackin, 2016), as well as applying a more holistic approach to chemistry in terms of "Bildung" vs. a more traditional scientific approach (Sjöström, 2007).

This means, chemistry teachers know that chemistry is everywhere and want the students' perspective, environmental and societal dimensions integrated. At the same time, most of them have the shared belief that learning and understanding chemistry is only possible in a systematic way, following the inner logic that has been established in many centuries. This is a "*curriculum dilemma*",

as (de Jong & Taber, 2014) called the decision when to implement certain specific content knowledge. It explains why it is so hard to implement new approaches. The resulting lack of relevance of traditional school chemistry from a student point of view, has e.g. been exemplified by research on differences in attitudes towards different fields of science. Chemistry is seen as rather "toxic", compared to "idyllic" biology (Krischer et al., 2016).

We were curious if this difference would be true in Norway, too, with a wealth of nature and at the same grounding their wealth on chemistry, especially oil production. Using the same instrument, we found similar attitudes and noticed, that the gap between "nature" and "chemistry" would be even wider for pre-service teacher students enrolling for non-scientific subjects such as languages, than that for pre-service STEM-teacher students (Höper, Janssen & Spitzer, 2017).

Approaches to address the problem of relevance include teaching chemistry with realistic contexts (Gilbert, 2006; Parchmann et al., 2006), or emphasizing education for sustainable development (Burmeister, Rauch & Eilks, 2012; Jegstad & Sinnes, 2015), alternatively visiting external resources such as factories, semi-natural outdoor-labs or science centres (Burmeister et al., 2012; Gröger, 2013; Thorsheim, Kolstø & Andresen, 2016). Still, one often ends up with either creating a new, artificial situation, spending a rather large effort to get things into the classroom, or trying to implement changes into a curriculum, which happens rarely, as discussed above.

We wanted to find out about how much change is realistic to integrate in a traditional curriculum for the individual teacher (Höper & Köller 2018). We implemented student-active learning sequences in the nearby environment with simple experiments, lasting not more than 5-45 minutes. In other words, we created a cultural outdoor place (Waite, 2017) that extends place and space and connects beyond the pure chemistry lesson (Popov & Höper,

2017). At the same time, the students' own mobile devices were deliberately used as part of this approach, to foster the students' digital skills and make it easier for them to get personal ownership to the approach.

5. Mobile technologies may help understanding how science domains relate to each other

Two examples shall help to visualize how we try to help students making their own chemistry learning relevant, making links to other disciplines, and thus lying the groundwork for integrating both different sciences and other aspects into their teaching.

5.1 Connecting concepts

The «Energy» concept is considered one of the "Big Ideas" in Science, central to understanding a wealth of phenomena in nature (Harlen, 2010). As discussed above, one could grasp the complexity of this concept. In our pre-service science teacher education, we observed that both biologists, chemists and physicists use energy in their contexts in their subject-specific language. We rarely link the different connotations explicitly, to foster an integrated understanding in the teacher students' minds. We therefore wanted to exemplify how the basic structures of the disciplines are interconnected and chose an integrated approach in our master course. A physicist was teaching about renewable energies, a chemist about chemistry in your food and body and a biologist for knowledge about ecosystems and biodiversity.

Instead of teaching all items independently, we chose to elucidate that everything is about energy, and focused on energy flow through an ecosystem, which is chemically stored in carbohydrates, fat and proteins, which again is the same as biomass and can be compared to other renewables such as wind- and solar energy. One central aspect in making this visible, was the iterative usage of the same outdoor arena for different aspects and inquiry-

based teaching, as proposed by Remmen & Frøyland (2017) in their "*extended classroom*"-framework.

To make short field trips possible, simple experiments and everything the students would need was put into a daypack, e.g. diabetes test-sticks as a simple test to detect glucose in plant-sap (figure 1), as described step-by-step in Höper (2017).

Figure 1 Urine sticks can be used to show glucose in plant sap.

Koehler & Misra (2009) state that teachers need to "develop skills to look beyond most common uses for technologies, reconfiguring them for customized pedagogical purposes." This is exactly what we are trying here, when forcing student teachers to deliberately misuse a medical device to analyse glucose-occurrences in nature.

In order to find out about how these outdoor lessons influence student teachers' understanding of chemistry as an integrated part of nature, we equipped the students with chest-mounted cameras. In a thematic analysis, we could see that they struggled with different challenges from technically ones via classroom management, to cognitive misconceptions (Höper & Köller, 2018). Regarding the integration efforts, we observed link-making to both subject-specific concepts, as well as biological topics, species

knowledge etc. Relevance, as defined by Stuckey et al. (2013), includes two dimensions, which seem to be fostered by this approach. Individual relevance, giving a motivational boost to conduct, discuss and reflect about the experiments. Vocational relevance was visible through the students' own valuation of this fieldwork as a meaningful tool, worth integrating into their own future practice (Höper & Köller, 2018). I think this is a good starting point for further linking to other topics like becoming a vegetarian or vegan, which will get a stronger scientific background, when based on an integrated energy-concept.

5.2 Making Chemistry visible through radiation

Another method could be even better suited to show that the world we experience is only a fraction of information, which is available about a given phenomenon. This is relevant, both macroscopic, with us only seeing a small part of the electromagnetic spectrum, but especially microscopic regarding particles and the properties of substances. Here again, it would be useful to start in the macroscopic world, before exploring microscopic aspects, e.g. by mounting an infrared camera (like FLIR-ONE^{TM}) to your or the student's phone, which gives an idea of gathering information outside the visible spectrum (figure 2).

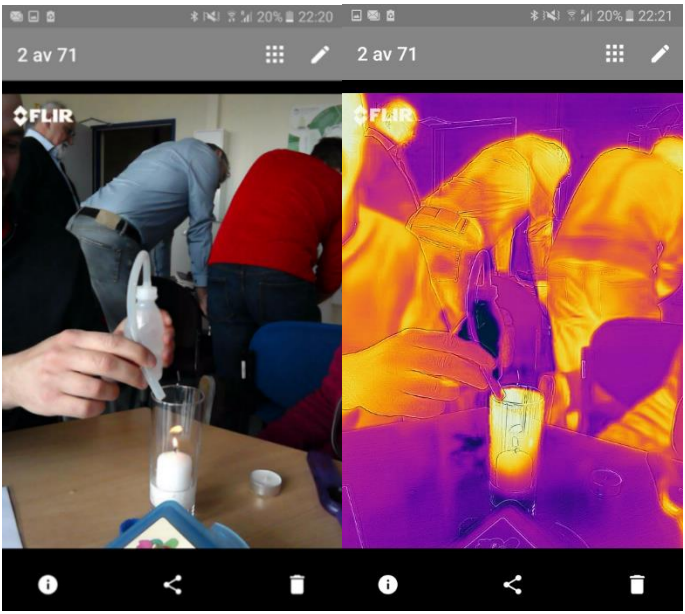

Figure 2 A mobile IR-camera is able to show the same situation in both infrared and visible pictures. Here during a workshop at the conference in Siegen.

A detailed discussion of school-relevant possibilities regarding chemistry teaching has recently been done by Green at al. (2020).

To transfer this effect to chemistry, and gathering information about the substances themselves, we use another device, which also works with infrared radiation, this time near-infrared. The spectrometer we use (SCiO™, fig. 3), is coupled to an application on your smartphone, sending the obtained data to a server, where they will be processed and sent back to your phone. The result will be shown as a spectrum (figure 4), and can be compared to a database of known spectra.

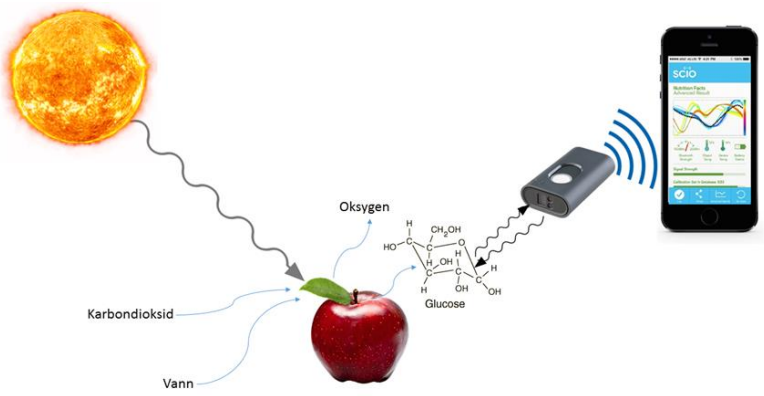

Figure 3 Different wavelengths contribute to create and understand a phenomenon, e.g. an apple.

Qualitative better information about substances can be obtained with the spectrometer, than with traditional detection reactions, for instance the Biuret reaction for detecting proteins, or Fehling reaction for carbohydrates. Different food items can be examined this way, even giving quantitative measures for certain substances in real time (Höper, in press). The crucial point here is to become aware of how the same physical phenomenon, i.e. wavelengths of the electromagnetic spectrum, are used differently, as illustrated in figure 3. First by the apple-tree, when gathering energy from the sun in photosynthesis to produce sugar. Second, by the spectrometer, when measuring diffuse reflectance in the near infrared. Third, in communication between the smartphone and corresponding devices like satellites etc. Last, but not least, our eyes, using the visible part of the spectrum, to interpret all these objects.

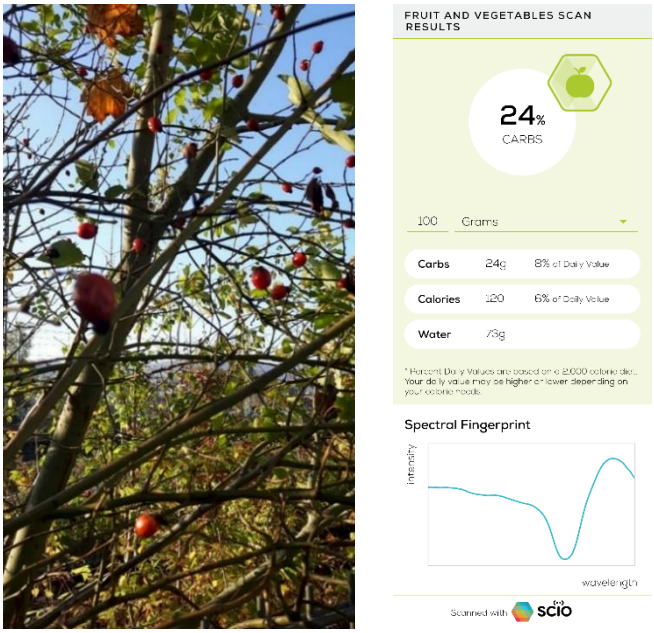

Figure 4 Real-time science data. A rosehip outside the conference in Siegen, and some chemical content, as measured by the device. Screenshot from the «SCiO Pocket Molecular Sensor" app (www.consumerphysics.com); The diagram shows the spectral fingerprint.

6. Conclusion

It is possible to integrate the natural sciences and more into one school subject, even in secondary and higher education. The technologies are in place, nature is waiting to be used. At the same time, all the challenges discussed above remain and will not disappear with ever increasing speed of research in all the scientific disciplines. The individual teacher's mindset and the will to collaborate is crucial, when trying to implement integrated elements. Hopefully, the focus on deep learning and multidisciplinary themes in Norway helps fostering the understanding of science.

Last but not least, here is a practical advice for teachers, who want to start integrating the outdoors. Our experiences with different kinds of outdoor approaches show that it might be easiest to cross the threshold by giving short cognitive assignments. These can last as little as five minutes and either serve as a starting point for new topics, or repetition at the end of a teaching unit. A challenge to take pictures of redox-reactions in the school-yard for instance, would only "steal" a few minutes from your traditional curriculum, while opening up for link-making of a typical "lab-topic" to real life.

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WORKSHOPS

Mareike Janssen

Exploring the things of life: First insights into chemical processes with sparkling water as an example

Chemical contents in primary school are widely regarded to be important as they support the development of a more scientific understanding of every day phenomena and thus prevent potentially impeding preconceptions. Furthermore, children at primary school age are motivated and have the necessary cognitive preconditions to cherish and understand chemical experiments.

At the University of Siegen, future teachers learn how to plan and conduct simple chemical experiments in a so called "food lab" using kitchen utensils and food items of everyday life. In this article, the advantages of such an approach are highlighted and illustrated by using sparkling water as an example to give children a first insight into chemical processes.

1. Introduction

Natural sciences are an essential part of primary school curricula worldwide (cf. Dillon 2009), including not only biological, but also physical and chemical contents. The latter are often underrepresented in schools due to the lack of knowledge and a feeling of incompetence coming from the teachers' side (cf. Altenburger & Starauschek 2011). Therefore, it is important to encourage future primary school teachers during their university education to implement chemical contents into their lessons. Using easily accessible and non-hazardous materials of everyday life can help to overcome a potential reserve towards chemical substances and also help to interest children in chemical processes, as they prefer topics related to their own environment (cf. Merzyn 2008). Sparkling water and effervescent tablets are an example for substances from the everyday experience of children which can be used to conduct

a variety of interesting experiments and find out about the properties of the gas carbon dioxide.

2. Chemical processes in primary school

The German curricula for primary schools largely follow the recommendations of the GDSU (Gesellschaft für die Didaktik des Sachunterrichts), in which biological, physical, and chemical aspects are shown to be equally important (cf. GDSU 2013). The curriculum of the German federal state North Rhine-Westphalia (NRW) also follows these recommendations. All three natural sciences are described under the sector "Natur und Leben" (nature and life) (cf. Ministerium für Schule und Weiterbildung des Landes Nordrhein-Westfalen 2008), and it is therefore obligatory to implement chemical topics into lessons of general studies (science and social studies at primary school level).

It has been shown that children benefit from an early encounter with natural sciences, which also includes chemical processes. They grow up in a world that is highly influenced by science and they have to learn "to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity." (OECD 2000, p. 74), following the definition of scientific literacy used in the PISA-study of 2000 (Programme for International Student Assessment). A first approach towards scientific contents and methods in primary school therefore helps children to acquire the necessary knowledge and competences which are part of a contemporary general education (cf. Dillon 2009).

A first approach concerning substances and conversion of materials can not only support the development of scientific literacy but is also suitable to implement more scientific ideas and thus to overcome possible preconceptions which might complicate further learning (cf. Möller et al. 2011).

Additionally, an early encounter with chemistry is part of the so-called STEM education (Science, Technology, Engineering, and Mathematics), which is considered to be essential to acquire enough scientific qualified employees in the future.

Children at primary school age do not only have the cognitive preconditions to understand basic scientific matters (cf. Prenzel et al. 2003), but are also interested in them (cf. Kleickmann et al. 2012). It is therefore advisable to use the motivation at an early age to begin with basic aspects of science education in schools.

2.1 Scientific methods in primary school

Students of general studies the University of Siegen learn methods to implement science in primary school. One approach is promoted by the "Haus der kleinen Forscher", a German non-profit foundation to support STEM education in day care facilities and primary schools. It describes a research circle that is based on the assumption that children can execute first scientific methods (cf. Marquardt-Mau, 2011). It starts with finding questions concerning an observed phenomenon, then the children collect ideas or presumptions about it, try and carry out experiments, observe and describe the outcome, document the results and discuss them. It is possible that further questions arise during this process, so the "circle" can start anew.

This circle is a recommendation for teachers and educators and does not have to be followed step by step; for younger children or more complex questions it is often sufficient to focus on single steps. Apart from supporting the development of method- and content-oriented competences like reading, making presumptions, carrying out experiments, writing a protocol, or finding explanations, it also helps children to develop process-oriented competences (social competences or self-competences) like working together, coming to agreements, sharing the work, or exchanging ideas.

3. Teacher qualification

Students of general studies at the University of Siegen have to attend a practical laboratory course in a so-called food-lab (see the article “FoodLAB” by Martin Gröger in this conference transcript) a room with a spacious kitchen in which they can conduct chemical experiments and learn how to implement them in school. The focus is on subjects and phenomena with reference to everyday life and the materials are easy to obtain and non-hazardous.

This approach is chosen to overcome possible shyness or even aversion towards chemical contents which is not uncommon amongst future primary school teachers and leads to the avoidance of chemical contents during their studies and a resulting feeling of inadequacy to teach them (cf. Tosun 2000). In contrast to a classical laboratory, an artificial surrounding in which chemicals are used and safety precautions are necessary, the food-lab is down-to-earth and creates a much less intimidating atmosphere. It is also much closer to the reality of primary schools, which often have a kitchen but no laboratory in which experiments can be carried out.

Topics of the laboratory course include water, colours and colouring, washing and cleaning, acids and alkalis, fire and flames, crystals and salts, Christmas-cooking, food components, and sparkling water. The correspondent experiment can be carried out in a kitchen with common kitchen utensils and everyday materials. The variety of subjects helps the university students to gain a solid professional foundation for their future teaching.

4. Sparkling water

Children are surrounded by substances and the conversion of matters, often without noticing them (cf. Woyke 2009) or without connecting perceived phenomena with chemistry (cf. Limke 1996). Excellent examples for this are sparkling water and effervescent

tablets, commonplace substances which can be used for a variety of fascinating experiments (cf. Haus der kleinen Forscher, 2013).

These experiments can help children to find out about the formation and the properties of carbon dioxide, the gas of the sparkling water. Carbon dioxide plays an important role in different contexts, not only in the kitchen or household, but also in chemistry and nature. One of the most important aspects nowadays is its contribution to the climate change, something children are confronted with and will have to deal with in their future life (cf. Solomon et al. 2009).

Dissolving effervescent tablets, baking powder or natron and an acid in water releases carbon dioxide, which can be used to displace water in a vessel, to extinguish a flame, to drive a boat or launch a little rocket etc. Some of the experiments which are used in the university course in Siegen and also the seminar in the second phase of the teacher training are described here.

Figure 1: Raisin lift

One example for a very simple but fascinating experiment is the "raisin lift" (see fig. 1). Raisins in sparkling water go up and down due to the carbon dioxide bubbles which attach to the rough surface. This increases the buoyancy and the raisin is lifted to the surface where the bubbles pop, the gas is released into the air and the raisin sinks again. This process continues until the carbon dioxide has escaped.

Another simple experiment is the “gas-balloon” in which a bottle is filled with a cup of water, an effervescent tablet is added, and a balloon is put over the bottle opening. The balloon is inflated by the carbon dioxide which results from a chemical reaction of water with the sodium hydroxide and acid in the tablet. The normally invisible gas thus becomes visible.

To show that carbon dioxide can extinguish a fire, a burning wooden stick can be put into a glass above some water with a dissolving effervescent tablet. This experiment also demonstrates that the carbon dioxide is heavier than the air because it stays in the glass.

In order to obtain carbon dioxide, another experiment can be performed. A bowl is filled with water and a tall glass is placed in the bowl in a horizontal position and thus filled completely with water.

The glass is than put in an upright position with its bottom on top and still filled with water. Now, one or two effervescent tablets are placed under the rim of the glass and the tablets begins to fizz. The resulting carbon dioxide replaces the water in the glass (see fig. 2) and with the help of a lid placed over the opening of the glass, the gas can be further used.

Figure 2: Obtaining carbon dioxide

A particularly astonishing experiment is to extinguish a candle flame by invisible carbon dioxide. A candle is put inside a glass, lighted and then carbon dioxide (for example gained as described

above) poured over the glass. The candle will die because the carbon dioxide replaces the air in the glass and thus the oxygen, a precondition for fire.

The property of carbon dioxide to be heavier than air can also be shown in a variation of the experiment mentioned above. Three small candles of different sizes are fixed in an empty tea-light holder and placed inside a glass. A little water is added to the glass (reaching not more than half the height of the tea-light holder) and an effervescent tablet is added to the water. The resulting carbon dioxide first extinguishes the smallest (lowest) candle, then the medium one and finally the largest one, because it gradually builds up inside the glass.

Another experiment has the form of a challenge to construct a fire extinguisher. The materials provided include, among other things, candles, a lighter, a small plastic bottle, straws, effervescent tablets, a tool to make a hole in the bottle lid and water. The best solution is to use a hole in the bottle lid and put a straw through it, dissolve an effervescent tablet in some water in the bottle and close the lid. The carbon dioxide pours out of the straw and can be used to extinguish a couple of candle lights.

5. Summary

Not only children can profit from an early encounter with scientific contents which are part of their everyday-life, but also future primary teachers can benefit from a qualification that includes a surrounding, materials and topics that are practicable and encouraging.

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Julia Gaffron, Martin Gröger

Children like to experiment, many teachers apparently do not

Strengthening and optimizing the self-efficacy and motivation concerning chemical experimentation of teachers of general studies (science and social studies at primary school level) in teacher training

1. Introduction

Children are highly motivated when experiments are carried out in general studies. Of course, spectacular experiments such as a rocket made with an effervescent tablet are more popular than those in which observations are to be made over a period of several days, e.g. the evaporation of water on the windowsill in the classroom.

It does not matter whether the experiments to be carried out come from the fields of chemistry, physics or biology, are integrated into a unit on a subject of general studies, or whether it is the experiment of the week in which various scientific or technical phenomena are presented in an experiment or carried out by the students themselves, possibly without further connections to general studies. Experiments are clearly a motor for motivation, which is also still present in secondary school (cf. Barke et al. 2018, p. 60; Frischknecht-Tobler & Labudde, 2013, p. 144; Reiners 2017, p. 105).

Experimentation in general studies can be legitimated not only motivational, but also didactical and following learning theories: Reading instructions, selecting the material unassisted, making assumptions, carrying out the experiment, observing precisely and also documenting in the researcher's protocol are professional methods in science lessons that can be worked on and performed by children at their individual levels within the framework of these lessons (cf. Grygier & Hartinger 2009). The search for the right

explanations and the understanding of what happened in the observed phenomena usually also drives the children to do further research and to pursue their own further questions, provided they can actually carry out many experiments in science lessons and are taught by a teacher who enables them to do so.

However, reality often speaks a different language: Own long-standing experiences as a primary school teacher and moderator in teacher training lead to the assumption that, despite all efforts and developments, experimentation in general studies is still far from finding a place in lesson planning in all primary schools, even though the NRW curriculum explicitly requires experiments to be carried out (cf. Ministerium für Schule und Weiterbildung 2008, p. 43). Pointedly formulated: Children like to experiment, but many teachers obviously do not.

2. Aim and research question

MÖLLER (2004) shows that in general studies the actual teaching of scientific topics - especially physics - is strongly dependent on the teacher's own motivation, professional knowledge[3] and self-concept. When science topics are taught, they are usually biological topics, the so-called “hard subjects” physics and chemistry are taught less frequently. SCHMIDT (2015) examines the relationship between the subject-specific professional knowledge, the educational background and teaching experience of teachers of general studies. Here, too, it becomes clear that a lack of professional knowledge, teaching of subjects outside their formal education, personal reservations (negative own learning biography), lack of interest and motivation as well as a lack of equipment or a high level of preparation and material expenditure are cited as reasons for the under-representation of scientific contents in teaching

[3] Concerning the role of professional knowledge in teacher training, see HARMS & RIESE (2018).

general studies. According to the study, the results are also particularly valid for the hard subjects of physics, chemistry and technology. ARMSTRONG & WÖHRMANN (2008) come to comparable results. Although these studies extend over a longer period of time, nothing seems to have changed.

"Experiments are [...] undoubtedly a constituent of the scientific disciplines" (Hofheinz 2008, p. 64). Experimenting or carrying out experiments is considered to be one of the essential characteristics of the subjects of chemistry and physics (cf. Reiners 2017, p. 37; Gebhard, Höttecke & Rehm 2017, p. 11). Although MÖLLER (2004) and SCHMIDT (2015) did not explicitly examine the performance of experiments in general studies in their investigations, it can be assumed that the results of the studies are also applicable to experimenting as a subject method in general studies. Based on these findings and with a view to the research project to be presented, the hypothesis is formulated as follows: *The genesis of a professional knowledge for experimenting in general studies is still not sufficiently established in qualification and everyday school life.*

In order to test this hypothesis, it can be assumed, in the light of current statistics (e.g. Quantita 2018/19 [4]), that natural sciences (with the exception of biology) only play a marginal role in a learner's school career. Thus, the statement by PRENZEL (2003, p. 37) that "in Germany, a cumulative development of scientific understanding across the school levels is insufficient" still applies today. It can therefore be assumed that the majority of teachers who studied general studies years ago and are now in teaching profession did not originally do so because of personal preferences for the subjects of physics and chemistry. However, the same is probably still true today for university students of general studies, who

[4] https://www.schulministerium.nrw.de/docs/bp/Ministerium/Service/Schulstatistik/Amtliche-Schuldaten/Quantita_2018.pdf [last access: 13.02.2020]

rarely study the areas of physics, chemistry and technology in depth as part of their university education, unless these are compulsory courses. Usually they choose biology or social sciences as a specialization instead. With view of the second phase of teacher training in the subject of general studies, the question arises as to how this situation can be addressed. Is it possible to compensate for possible existing deficits and reservations in the second phase of teacher training, which result from one's own learning biography and/or university education, with regard to the hard subjects in general - and here in particular for experimenting on chemical phenomena?

This is where our research on experimenting in general studies - strengthening and optimizing of self-efficacy and motivation of teachers in teacher training - comes in. It is to be examined whether it is possible, in the course of the second phase (teacher training), to motivate future teachers to experiment in general studies by means of targeted measures and to impart the necessary professional knowledge to them. The research question is: Can an explicit intervention for experimenting in general studies using the example of fizzy gas strengthen the motivation, self-efficacy, and professional knowledge of trainee teachers in the long term?

3. Research Design

In the study we use a mixed-method approach, in which the data are first recorded quantitatively and then deepened qualitatively (see Kuckartz 2014, p. 78ff.).

The concepts *motivation, self-efficacy* and *professional knowledge* are quantified using a combination of already validated, closed questionnaires with rating scales from JANSSEN (2015, p. 181ff.) and MÉZES (2016, p. 238ff.) in a pre-post design. Thematically, the interest in experiments (in school and extracurricular) is surveyed. Further items refer to the self-assessment of already existing

professional knowledge and the self-efficacy expectation or self-concept. Based on SCHMIDT (2015, pp. 206ff.), the pre-test contains additional questions on the (scientific) educational background of future teachers.

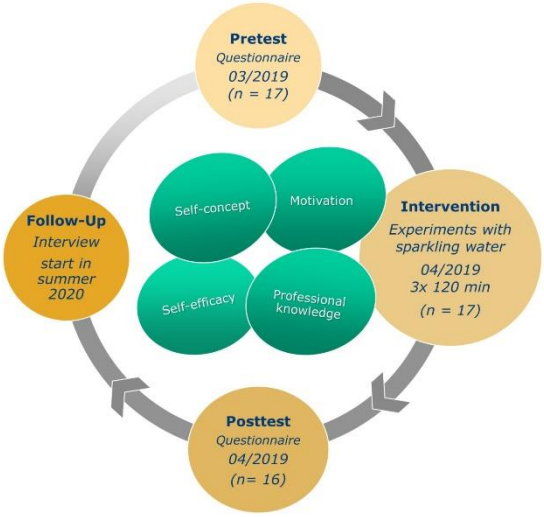

Figure 1: Research Design

Semi-structured, open, facultative follow-up interviews allow statements after about two years about the long-term development and/or change in professional knowledge, self-efficacy and motivation with regard to experimentation in primary school (see figure 1). As a qualitative method, the interviews not only allow for a *between-method* triangulation (cf. Kuckartz 2014, p. 47), but also serve as components of a context analysis to explicate the potential of the entire intervention. At the time of the interviews, the teacher trainees will have completed their training (successfully) and will have a (permanent) position as teachers in a primary school. After a period of settling in, they should then have a certain amount of professional experience in everyday school life in order to be able to make statements on how to conduct experiments in their general studies. It is expected that the interviews

will not only allow to assess the current personal experience and attitudes towards experimentation in science education in comparison to the information provided in the questionnaires, but also show that experimentation in science education can be supported or even hindered by certain measures.

4. Intervention

Within the framework of the training in teacher training each subject is based on seminar plans. For the subject general studies this means: The numerous didactical and methodological aspects of lesson planning and implementation are usually illustrated and worked on using concrete contents from general studies. The selection of contents is based on the guidelines and the curriculum (cf. Ministerium für Schule und Weiterbildung 2008). As a multiperspective subject, general studies offer numerous contents, topics and possible practical examples. When planning seminars, all reference disciplines or curriculum areas must be given appropriate consideration. An intervention measure that conforms to the training and is approved by the responsible Ministry for School and Education must therefore be tightly timed and can only comprise a few seminar sessions.

Specifically, three events are scheduled, each lasting 120 minutes. In addition to the technical input on the subject of fizzy gas/carbon dioxide and the subject-methodological input on the issue of experimenting, the focus is on getting to know and trying out as many experiments and tests as possible independently. Putting themselves in the position of the children who carry out experiments (with and without instruction), enables the trainee teachers to recognise learning opportunities and obstacles in an authentic way. A role-change back to the teacher's role and thus to the learning guide of the children opens the chance for a deeper didactic reflection. This form of the *pedagogical double-decker* (cf. Geißler 1985; Widulle 2009, pp. 76f.), which requires a constant change of perspective and thus also a high degree of flexibility and ability to

reflect, has proved its worth in education (cf. Abels 2011, pp. 124f.). To ensure that the intervention offers sufficient opportunity for practical experimentation and discovery on the one hand and that there is sufficient time to do justice to the high demand for reflection on the didactical and methodological planning and implementation of instruction on the other hand, the three events are planned and structured according to the *cognitive apprenticeship* approach (Collins, Brown & Newman 1989).

5. Sparkling gas - a chemical topic in general studies

The theme chosen for the intervention was "Experimenting in the classroom using the example of sparkling gas", as it seems particularly appropriate:

- The sparkling gas (carbonic acid) in a soft drink, the vitamin effervescent tablet, the sherbet powder sachets, fizzy sweets or the fizzy tablets for a bath - all these are things that primary school children most likely know from their everyday life. As a rule, they also have a positive connotation. This means that the topic is motivating and relevant. Questions like "Why does an effervescent tablet bubble" or "How do the bubbles get into the water bottle?" can actually be asked by children in this way or a similar way. The various associations concerning fizzy gas, the relevance for everyday life and the questions asked by the children provide a good introduction to a unit on the subject of sparkling gas.

- A number of experiments can be carried out with children on the subject of sparkling gas, which can be easily planned by a teacher with the appropriate didactic reconstruction without a great deal of time and material expenditure. Most of the experiments can be carried out by the children themselves in order to train their experimental skills. The phenomena to be observed are vivid

and unambiguous and can also be easily described in colloquial language or developed in technical language to promote language skills.

- The scientific (chemical) explanations of the experiments relating to carbon dioxide can be developed with the children on the basis of the observations made during the experiments as the properties of sparkling gas. Since the experiments build on each other and successively more properties become clear, at the end of the unit the children should have the knowledge that real researchers call sparkling gas carbon dioxide, that it is colourless like air, takes up space and exerts pressure, is "heavier" than air, extinguishes burning candles and is formed from carbonic acid. The question "Why does an effervescent tablet bubble?" is also answered when the children realize that every effervescent tablet must always contain two very specific components that react with each other when they come into contact with water to produce carbon dioxide.[5]

- With regard to the differentiation of learning contents in heterogeneous learning groups, the topic of sparkling gas is suitable for offering children different approaches to experimentation according to their individual performance levels: Performing experiments (with instructions), pursuing a research question yourself (experiment without instructions) or observing a demonstration experiment. Likewise, the scientific contents can be

[5] In addition to the chemical content arising in the experimental context of the experiments on sparkling gas, the topic is also suitable for addressing the aspect of carbon dioxide as one of the causes of climate change in the context of Education for Sustainable Development in the classroom.

differentiated and conveyed in the sense of graded requirement areas.

6. First results and outlook

After reviewing the pre-test and post-test questionnaires, initial trends can be identified:

With regard to the characteristics interest, motivation and self-assessment of professional knowledge and self-concept, values emerge which show that the teacher trainees are generally positive and consider themselves to be quite professional after a training period of about 11 months (of 18 months of teacher training). Overall, the willingness to carry out (chemical) experiments as a teacher in general studies seems to be high. This is initially surprising, as it would contradict the studies on professional knowledge mentioned above. An effect of social desirability can possibly be assumed here (see Döring & Bortz 2016, p. 437f.). It is also conceivable, however, that it could be attributed to the special situation in teacher training: The so-called second phase of training is a time in which didactical, scientific, methodological and pedagogical topics are worked out in all subjects/areas of training in a very intensive and concentrated manner, which are then implemented and reflected upon in class with the advice and support of mentors and seminar trainers. In this respect it is not surprising that the future teachers assess themselves as competent. It remains to be seen to what extent these initial tendencies of pre-/post-tests can be specified after further evaluation, also against the background of school and university education. The follow-up interviews to be carried out later will show to what extent this attitude and assessment of teachers towards experimentation in everyday school life has been maintained or changed. Have teachers established experimentation in the classroom or are there reasons that prevent them from doing so?

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Volker Heck

Alexander von Humboldt - The Voyage to the Americas as an approach to science in Primary School

In the year of Alexander von Humboldt's 250th birthday, this article is intended to show his research spirit for subject didactics and teaching in general science in primary school´s subject teaching (Sachunterricht). Furthermore, it is in the best sense of the research traveller, this is about making the connection between the German primary school to the conditions in Colombia, as one of Alexander von Humboldt's central research areas.

In addition to the geographical description of travel and space, a possibility is shown to implement cooperation based on teaching content beyond national and continental limits and thus to teach the students of general science in elementary school in terms of education for sustainable development and global learning to gain access to the content of the subject of general science.

After all, Humboldt's idea that the large connections on Earth not only have to be scientifically exact, explainable and understandable, but also have to be aesthetically coherent is a particularly good basis for the multi-perspectivity of modern teaching.

1. Introduction

Alexander von Humboldt´s travels and his approach to both people and environment of Latin America and Asia can be taken as an example as to how to interact between cultures and to make the best of the state-of-the-art technology back then. Today we consider him as the first holistic thinker, his methods and findings are a good basis for environmental and science education in the context of STEM at school.

2. The American Voyage

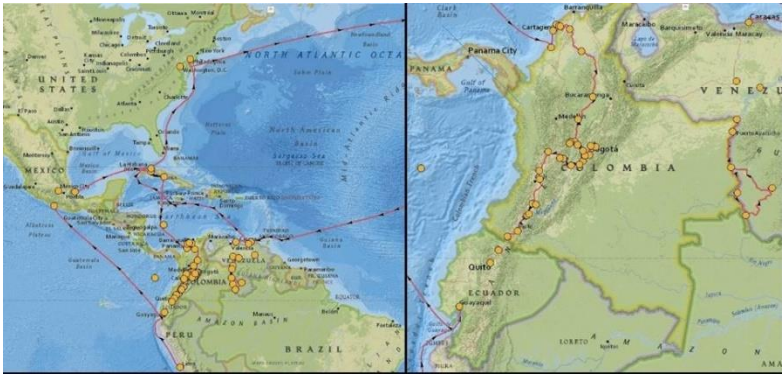

Fig. 1: Humboldt´s travel to the Americas, the cut-out shows the route he took through the viceroyalty of "Nueva Granada". Source: www.geoatico.net.

Alexander von Humboldt first travelled to the then viceroyalty of New Granada and Cuba, after that to Peru via New Spain (Mexico) and back to Cuba, and finally to the United States of America (cf. fig. 1 left). The map on the right shows the famous travel sections in today's Venezuela with the Río Casiquiare connecting the Río Orinoco and Río Amazonas. He then explored the Andean cordillera from north to south, from the Caribbean coast in today's Colombia, the Avenue of the Volcanoes in Ecuador and western Peru to finally reach the city of Lima.

After further stops in the Caribbean, Alexander von Humboldt was able to create a cross-section in Mexico, representing the contrasts between the Pacific and the Caribbean. After all, his maps were of great interest for the USA, as they contained important information about the regions to the west of the country border which then was the Mississippi River.

The relevance of the intersection of height and position becomes particularly clear when Humboldt's American research trip is considered in detail. He used tarmac days as well as rests tirelessly for

his scientific work. Starting from La Coruña to the southernmost point of his trip in Lima, he collected countless data from different climates. These include measurements from the Canary Islands in June 1799, navigation of the Río Orinoco and Río Negro in 1800 and sailing in the Caribbean, including a three-month stay in Cuba until 1801. The central part of the trip though was made through what is now Colombia and Ecuador with the Avenue of the Volcanoes to Peru from mid-1801 to the end of 1802, before Humboldt travelled across the Pacific to Mexico in the first quarter of 1803, crossed the country from west to east. Finally, the voyage lead to the USA via Cuba in March 1804 back to Europe (Faak, 2000, 2003 and 2015, Heck, 2019).

On the basis of Alexander von Humboldt's diaries, Bruhns published a summary of a total of 417 observation days, 201 localizations and measurements in the 19th century (Bruhns, 1872).

By combining different techniques, such as determining the position and observing natural phenomena, Humboldt understood how to make even longer transit passages scientifically usable. Thus, the first exact maps of the course of the Río Magdalena go back to him. He drew in his diary on the way to Bogotá and supplemented his maps with vegetation studies. These form the basis for vegetation height profiles still today.

Furthermore, he made excursions to individual sites, hoping for to learn: in the course of his stay in the province of Popayán he noticed recurring weather phenomena around the isolated mountain bed Tetilla de Julumito. The geological peculiarity of the site as well as the relief-related structure were then captured by Humboldt in his travel diary (Faak, 2003), which also examined the existing vegetation and soil. Finally, Humboldt made a drawing of the situation and a profile of the central Cordillera with the places known to him and visited by him (Heck, 2019 and Heck, 2020).

3. Equipment and Learning

In his time, Alexander von Humboldt represented the connection of discovery and its localization like no other researcher. This can be understood in particular by means of contemporary paintings. For example, Humboldt is shown in the midst of the tropical environment, frequently, as in the following work by Friedrich Georg Weitsch (cf. fig. 2), surrounded by exotic plants in the botanical determination.

However, these height measurements alone are not sufficient for a holistic view of a room. The explorer Humboldt used a Hadley sextant with artificial horizon and was thus able to specify the exact lengths and widths for each height determination and thus to locate his observations exactly.

Fig. 2: Alexander von Humboldt and Aime Bonpland resting during the expedition. Source: Wikipedia.

The depiction is very typical, as it gives Humboldt a certain dominance by highlighting him from the rest of the painting. In addition to the wide grasslands and palm trees making the tropical landscape, the altitude levels are indicated by the mountains in the background. In addition to botanical material, on the table there are various technical instruments used during the voyage.

As one of the first explorers, Alexander von Humboldt succeeded in making exact positioning not only on the sea but also on land. For this he used a sextant with an artificial horizon to determine the position, and a barometer for height determination. This is one of the basic requirements to compare the observations and measurements made in America to those from other parts of the world and finally for creating the "world painting".

3.1 Humboldt´s Self-Made Instruments as a concept of a learning tool for extracurricular learning

During his expedition Humboldt was able to use the best instruments available at the time. Today´s pupils can follow several of the measurements then made with self-made apparatuses made of everyday materials. Thinking in how to construct and afterwards use these apparatuses also outside the school building gives students the opportunity of getting involved with science and technology. Education for Sustainable Development can easily be picked as a central topic and making learners aware of the environment and possible environmental hazards in all parts of the world.

In didactic literature comprises many different recommendations for the construction of instruments such as thermometers or barometers. In addition to the use of everyday objects, the challenge is to create a robust structure, so that the instruments can be taken and used outdoors. However, a large variety of measuring instruments for the exploration of the school environment or, after appropriate training, for excursions, can be made available.

In most parts of the country the equipment of Colombian schools is much worse than in German schools. There also is so far, a lack of the necessary approaches and concepts that might enable extracurricular learning in Colombia. In Colombian primary schools, especially in general studies, the subject "natural sciences and technology" (STEM) includes biological, environmental and technological contents, which correspond to the subject areas "nature and life" as well as "technology and profession" in teaching. Social sciences deal with geographical, social, cultural and historical content. Informatics is offered from the third grade onwards. Traffic education and mobility has only been a mandatory component of primary education since 2002. So far, however, these new contents are taught without a standardized curriculum. Student laboratories are currently not yet available for extracurricular studying in Colombia.

According to the limited resources in primary school in Colombia, concepts are required for out-of-school learning, without additional financial resources.

The frequently inadequate equipment of schools is compensated by the fact that students independently construct the necessary equipment and instruments. Every-day materials, for example in the household or by cheap on-site items can be used.

The aim of a cooperation between the University of Siegen and the Universidad de Antioquia is to develop and test a learning kit to support science teaching and learning. The use of the “suitcase” at hand will be will be implemented in the curriculum.

Adapting out-of-school learning in a student laboratory located at a university is impossible for the major part of Colombia due to the geography and nature of the country. Therefore, it was considered to develop a concept for Colombia, which is feasible for schools. Out-of-school learning should therefore be organized and carried out by the respective teachers in schools. After

appropriate training in workshops at school. Central aspects of out-of-school learning in the school lab need to be translated into dealing with a learning case.

Despite the challenging situation, many aspects can be taken for an extracurricular learning concept in Colombia. In particular, it will be crucial to focus on environmental issues and the design of (measuring) equipment to be read from the syllabus.

In the following, the concept of a learning case developed by the geography and physics didactics of the University of Siegen especially for the demands and conditions of scientific learning in Colombia is presented.

The envisaged learning toolkit both provides guidance for learners on the design of measuring instruments as well a manual for teachers to use it. As part of science lessons, students can build measuring instruments based on detailed descriptions and supported by the teachers. Based on the contents of the Colombian curriculum (Militschenko, Zuleta & Heck, 2018), (measuring-) instruments such as a thermometer / thermoscope, pendulum and hourglass, spring balance and compass have been considered or developed. Stored safely in a suitcase, these instruments can then be used in different places. During an excursion, students can explore the instruments and how to apply them correctly.

The autonomous creation and use of instruments allow learners to be highly active. Out-of-school places, especially on excursions intensively and persistently dealing with science and technology, the observational and discovering skills can consequently improve.

Geographical as well as environmental physics contents linked with biological questions are main targets of the described project.

3.2 Magnetism and Inclination

Inclination is the direction of the magnetic field lines. These inevitably run between the respective magnetic poles of the earth. The inclination is 90 ° at the magnetic north pole and -90 ° at the magnetic south pole. In measuring the inclination at a certain point on the earth, the instrument (Inclinatorium) must be aligned parallel to the imaginary line between the north and south poles as shown in the following figure (cf. fig. 3).

Fig. 3: Measurement setup to determine the inclination in one place. The parallelism of the inclinatorium and the connecting line of the magnetic poles is important. Photo: Volker Heck.

The following table shows the relationship between geographical location and inclination for some of the locations visited by Alexander von Humboldt amongst others. These are cities in the Andes, both in the north and south of the geographical equator, as well as stations in Germany. Basically, there is an increasing inclination from the southernmost (La Paz) to the northernmost station (Bremerhaven) and the difference between the geographical location and the position in relation to the magnetic pole can be seen just as clearly. The greatest influence is the latitude, whereas the geographical longitude only has a modifying effect, as do certain

geological structures in the (geological) subsoil, (locally) affecting the earth's magnetic field, for example through magnetized rocks.

Location	Latitude °	Longitude °	Inclination °
Bremerhaven	53.32 N	08.34 E	+ 72
Monschau	50.34 N	06.15 E	+ 69
Siegen	50.23 N	08.03 E	+ 70
Copacabana (Colombia)	06.35 N	75.50 W	+ 21
Popayán (Colombia)	02.26 N	76.36 W	+ 17
Quito (Ecuador)	00.12 S	78.29 W	+ 11
Nazca (Peru)	14.49 S	74.56 W	- 01
La Paz (Bolivia)	16.29 S	68.08 W	- 03

Data given in the table also reveal the approximate location of the magnetic equator, which in South America runs roughly through the city of Nasca at 15 ° S a fact that is even better to be observed on the map of the world magnetic Model (c.f. fig. 5).

The following illustration (c.f. fig. 4) shows the different deflections of the inclinatorium in different places (Siegen and Quito) of the world:

Fig. 4: The use of an inclinatorium in Siegen (left) and Quito (right): Clearly observable is the difference of inclination. Photo: Volker Heck.

Finally, the distribution of the inclination including Earth's magnetic poles can be made visible using the following map (Fig. 5).

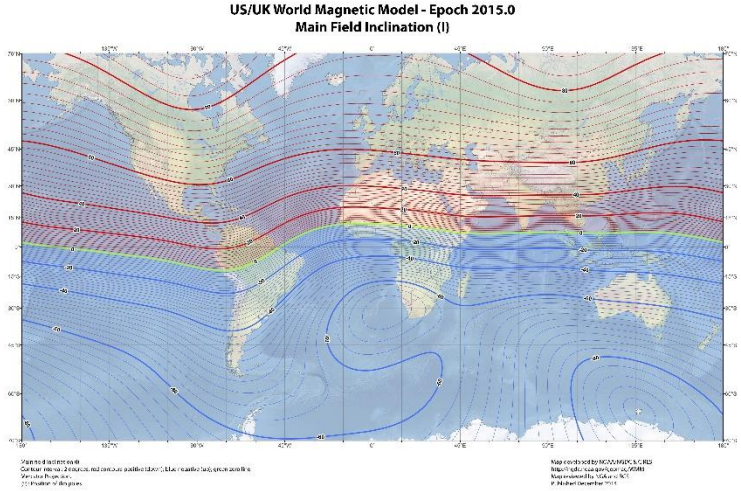

Fig. 5: A closer look at the magnetic south pole (dip at the bottom right of the map and explanation in the legend of the figure) apparently distant from the geographic south pole during the observation period Source: NOAA 2014.

The earth is surrounded by a magnetic field that has its south pole near the geographic North Pole, namely the magnetic North Pole, and similar for the South Magnetic Pole. Thus, it is clear that the red (southern) end of a conventional compass needle points to the magnetic North Pole, and usually the white end of the needle on the magnetic south pole. If a person travels north or south, the magnetic field changes from + 90 ° on the Magnetic North Pole to – 90 ° on the Magnetic South Pole. Areas in between, such as the tropics will have values close to 0 °, as to be seen in fig. 5.

Alexander von Humboldt measured these changes during his voyage and afterwards drew a map of the so-called inclination on Earth. These measurements can be made in different parts of the world as part of international school-partnerships.

In the course of his further journey through the south of Colombia and the north of Ecuador via the road of the volcanoes, he finally reached the Chimborazo on 23.06.1802. Humboldt finally summarized his diary records in 1849 in “Ansichten der Natur”.

Based on the data presented in this paper, Alexander von Humboldt's interdisciplinary approach becomes clear: he knew how to use his own insights, such as to combine the trigonometric height calculation of a mountain and the position it actually reached. At the same time, he referred to other peaks in South America, even if he never reached them personally - such as the Aconcagua and the Sajama - even. By referring to *Saxifraga boussingaulti*, Humboldt demonstrated its occurrence beyond the snowline and he also showed the ecological adaptability of this mountain plant. With the reference to the alpine species *Silene aucalis*, he succeeded in making a botanical comparison between the species ascending in the tropics and temperate latitudes of the planet (Heck, 2019).

4. Summary: The World Painting

The study of the tropics and the extra tropics formed the basis for Humboldt's famous world painting, which visualizes his thinking. Impressively and in a way never achieved before, he managed to combine scientific knowledge with his aesthetically shaped idea of harmony in nature and to map vegetation levels in the different climatic zones of the earth by using his analysis of the changing vegetation of characteristic species by their appearance and disappearance in the respective latitudes and the altitude levels above the sea detected.

The extensive research trips to the so-called New World as well as through Europe and Asia finally led Alexander von Humboldt to develop thematic maps of the world (Berghaus, 1850). The representation of plants´ distribution on the mountains in various climatic zones is groundbreaking. Alexander von Humboldt stated

the climatic snow line and combined it with the average annual temperature and the respective temperatures of the coldest and the warmest month of a certain place (cf. fig. 6).

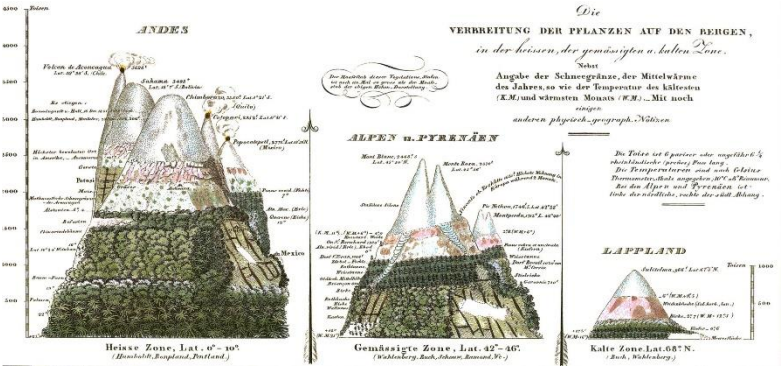

Fig. 6: The culmination of Humboldt´s work as to be achieved also in subject teaching "Sachunterricht" by combining the knowledge from all including perspectives. Humboldt did that by integrating the data he took in different places of Earth. (Source: Berghaus, 1850).

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Thomas Sukopp

Interculturality in Philosophy Education: Challenges and Prospects of Education for Sustainable Development in Primary Schools

This contribution sketches the theoretical framework, methodological assumptions, the design, and the results of two 45-minute units conducted in primary schools (third-grade) in Argentina, Brazil, Germany, Tunisia, and South Korea. The overall topic was whether and how pupils are capable of thinking morally about aspects of pollution in the context of Education for Sustainable Development (ESD). We raised the following three questions: 1. Are there significant cultural differences—or, at least, minimal cultural universals—as regards environmental awareness and moral thinking (e.g. 'natural moral sense')? 2. Is Philosophizing with Children (P4C) a concept that is applicable in elementary schools and in basic education, i.e. is it fruitful to develop competencies and skills beyond typical philosophical reasoning (e.g. in elementary science education)? 3. How can Education for Sustainable Development be initiated in intercultural contexts? We could partly yield positive results, especially regarding pupils' ability to change perspectives and their willingness to adopt a pathocentric view towards suffering animals. Some of our results—limiting ourselves to Questions 1 and 2—are presented and will be very briefly interpreted.

1. Introduction: Research Questions

Our main question is[6] whether, and in which respects, children at the age of eight to 10 years (third grade) are capable of moral

[6] The design and evaluation of our research project is part of collaborative work with my colleague Christian Prust. I am indebted to his expertise and frequent support. The project (runtime 2016–21) is part of an interdisciplinary cooperative research project "Cross-linking elementary science education [German "Sachunterricht"; TS]—opening perspectives"', generously funded by the Ministry of Culture, Science and Humanities of North Rhine-

thinking in the context of Education for Sustainable Development (ESD). Contrary to the views of e.g. Piaget and many other philosophers and educators (Ebers & Melchers 2006, 24ff. and 81ff.), we assume that children have, in fact, basic capabilities to achieve moral thinking. The following questions are closely related to our main question, and open up a rich field for theorizing as well as for empirical studies:

1. Are there significant cultural differences—or, at least, minimal cultural universals—regarding environmental awareness and moral thinking (e.g. 'natural moral sense')?

2. Is Philosophizing with Children (P4C) a concept that is applicable in elementary school and basic education, i.e. is it fruitful to develop competencies and skills beyond typical philosophical reasoning (e.g. in elementary science education)?

3. How can ESD be initiated in intercultural contexts?

All these questions cannot simply be affirmed, or be answered in the negative. Only the combination and interaction of empirical results and theoretical reflection can show whether and in which respects these theses and questions deserve an affirmative answer. This contribution focuses on Questions 1 and 2.

Westphalia (see http://www.uni-siegen.de/start/news/oeffentlichkeit/641529.html). The disciplines involved are History, Biology, Chemistry, Physics, Geography, Social Sciences, Didactics of Elementary Scientific Education (German "Sachunterricht"), and Philosophy. The subject Sachunterricht might be compared with propaedeutic scientific education in Grades 1 to 4. It aims at a basic understanding of subject areas that are discussed in the following disciplines: Physics, Chemistry, Biology, Geography, and History. Topics are, among others: Human beings and their relationship with the environment; animals and human beings from biological perspectives; basic scientific phenomena, e.g. light, mass, etc.; basic understanding of natural phenomena, such as weather; observing and describing transformation processes of organisms, etc.

Since the title suggests that interculturality is important, we will explore a large-scale theoretical and conceptual framework in Chapter 2.

2. Framework and relevance from an Intercultural Perspective

The wider context of this research on development of moral reasoning can be sketched as follows: On the one hand, theories of education differ as to what education means: It can be understood as vocational education, as *Bildung* (in the sense of upbringing or formation of personalities), as acquisition of competences (in the sense of output-oriented skills), as the cultivation of humanistic and entirely philosophical virtues and values, and so on (see e.g. various contributions in Phillips 2014, esp. Hand 2014). Theories of Education, Philosophy of Education, Pedagogy, and Didactics (as one part of Pedagogy) are certainly more than armchair disciplines without relevance to practical issues. Following one prominent conception, teaching as guided, well-performed, and well-directed learning is something entirely different from reflecting on the entire meaning of morals or ESD.[7] This contribution aims to motivate and encourage practitioners to engage in the theoretical issues relating to ESD. Since there is not necessarily a strong divide between theory and practice, we will argue that theory matters for an improved ESD. For didactical purposes, we consider the following distinctions and deliberations to be useful (see e.g. Sukopp

[7] It is beyond the scope of this paper to elaborate a detailed theoretical account of ESD (see e.g. Kioupi & Voulvoulis 2019; Kahn 2008). According to the three-pillar principle of sustainability, the economic and ecological aspects can be complemented by the idea of social sustainability (esp. Empacher & Wehling 2002; Pufé 2014), according to which sustainable actions, too, especially globally, cater to the protection of the basic needs and distributive justice. If we apply both possible meanings of sustainability to our project, P4C, it can be seen that P4C—when successful—enables education for sustainable actions. This means that the engagement with the topic of sustainability teaches an operational principle, which—if it has been internalized—lasts and impresses for life. In the best case, P4C satisfies both meanings of the term 'sustainable'.

2013, 190–199). I will only refer to a few advocates of an intercultural philosophy that respects plurality and diversity, but nevertheless think that these constraints do not exclude the very idea of universality, as Jing-Bao, (Raimon) Panikkar, or (Martin) Wimmer and Ram Adhar Mall argue.

> […] *there are no cultural universals*, i.e. concrete meaningful contents valid for all the cultures, for mankind throughout all times. What one calls human nature is an abstraction. And every abstraction is an operation of the mind which removes (abstracts) from a greater reality (as seen by this mind) something (less universal) which it considers as important. There cannot be cultural universals, for it is culture itself which makes possible (and plausible) its own universals. (Panikkar 2000, Para. 55)

This does not contradict the view that nevertheless something is universal, i.e. "human invariants" (Panikkar 2000, Para. 58), such as basic biological constraints and basic human needs like shelter, housing, food, etc. In spite of some more or less radical versions of cultural relativism, we argue that interculturality has to consider the following dialectical relationship between relativity and universality with respect to issues of ESD: Whatever 'culture' may be, there are no monolithic, strictly separated cultural blocks. We find interculturality within each culture, since interculturality is inherent to the human being, and a unique culture is as incomprehensible and impossible as a single universal language and as one man alone. "All cultures are the result of a continuous mutual fecundation" (Panikkar 2000, Para. 96) If we are looking for a "comprehensive understanding of human culture, we should accept interculturality. Interculturality means neither one (single) culture, nor a disconnected plurality" (Panikkar 2000, Para. 99). As a consequence, overlapping rational consensus in terms of minimal ethical universalism is one fruitful working thesis. More specifically, "the general applicability of the concept of philosophy remains unaffected by our recognition and acceptance of more than one

genuine philosophical tradition" (Mall 1998, 17). Related to the project, which aims at asking third-grade pupils what they think about aspects of pollution (see Ch. 4 and Ch. 5), we are inclined to look not only at cultural differences. Rather, it is a motivation to look for universals, for that which we share, which we have in common. In fact, moral reasoning—as one essential part of Philosophy—is an enterprise of mankind, and it accepts universal standards of argumentation, and, as a common-sense realist, I think that we live nearly in the same world. Even if this is true, Philosophy can "still remain compatible with the internal cultural differentiation'"(Mall 1998, 15).

Without going into details, we will list three further important aspects that will highlight the wider intercultural relevance of our project:

Ad 1: There is without doubt a worldwide relevance of topics like a) sensitivity towards cultures without abandoning universality (e.g. of thinking and reasoning etc.), b) children's thinking on aspects of ESD: "The UN Decade of Education for Sustainable Development (2005–2014) sought to mobilize the educational resources of the world to help create a more sustainable future" (UNESCO 2019). One goal that is explicitly put forward is e.g. "Stimulating learning and promoting core competencies, such as critical and systemic thinking, collaborative decision-making, and taking responsibility for present and future generations." (UNESCO 2019)

Ad 2: Basic principles of intercultural pedagogy (Auernheimer 2015) can easily integrated into the project, since intercultural pedagogy aims at principles of tolerance and promotes the capability to change and adopt different perspectives, encourages us to engage in attitudes of justified tolerance, as well as aims to avoid and overcome ethnocentric prejudices and paternalistic attitudes towards different cultures.

Ad 3: Interculturality is one pedagogic principle that is deeply rooted as a core capability of being able to develop fair and rational argumentation—in the context of divergent points of view—in pluralistic societies.

Since our project is not only devoted to interculturality but to P4C, it will be worthwhile to focus on the main theoretical aspects of P4C.

3. Theoretical assumptions and hypotheses regarding Philosophizing with Children (P4C)

Here, P4C does not refer to primary scholars engaging with the history of philosophy, as older pupils might in philosophy or ethics classes. We would rather understand P4C, with regard to Lipman, as a methodic-didactical concept (cf. especially Lipman, 1986; Eng. 1974) that can, on principle, be used in any subject, but especially in Sachunterricht (see Endnote 1) on account of its open but custom-fit curriculum, to support the subject matter, and to connect and harmonize teaching and its contents with the pupils' living environment. To achieve the latter, especially dialogically creative methods (cf. Martens 2005; Matthews 1989; Brüning 2014; Michalik 2015) and, fundamentally, the method of the Socratic conversations (SC) are well suited.[8] As a rough outline, SC are a teaching method—based on a moderated group discussion—that encourages self-critical, reflective, and argumentative thinking. SC ideally start with direct environmental issues and become more and more complex (cf. Martens 2005). This, of course, does not mean that teachers cannot introduce an SC with a provocative theoretical question and vice versa to make the theoretical issue a

[8] At this point, we do not differentiate between the different streams that exist when it comes to philosophizing with children, but we apply a very wide definition of P4C. The terms "children's philosophy", "thinking with children", or "philosophizing with children" will be used synonymously. Also, SC for the purposes of our research is—as a working hypothesis—similar to neo-Socratic dialogues, though elaborated neo-Socratic dialogues take much more time and require a special further training of teachers.

concern closely linked to the pupils' lives by amazing them and moving them.

We assume that SC is also important to improve children's capability to think on their own, to improve their sense of empathy and changes of perspectives, to express emotions, to justify their own assumptions and claims, etc. (Egan & Cunt & Judson 2014). In fact, we use a very wide conception of SC that is applicable without long preparations and can be summarized as initiating reflective, thoughtful dialogues with children. Therefore, we think that is realistic and fruitful to establish some standards like a) Try to think in accordance with your own thoughts; b) Do you really think what you just have expressed; c) Does anyone disagree? d) Always try to explain and justify what you think if anyone asks you to do so; e) Let others finish speaking; take the statements of others seriously, etc. The following research hypotheses have been partly empirically tested (for results, see Ch. 5).

Hypothesis 1: a) Children in the age of 8–10 are *not immature* persons who are simply not adequate interlocutors; b) P4C is a flexible instrument to initiate thinking processes; c) The results of thinking cannot be predicted.

Hypothesis 2: Teachers should not control pupils' thinking but, of course, should sometimes intervene moderately and sensitively.

Hypothesis 3: Minimal standards of ethics are essential (universalization, change of perspectives, willingness, and ability to give rational arguments, etc.), at least when we take the parlance of "moral thinking" seriously.

Hypothesis 4: One research result might be that Hypothesis 3 especially is too ambitious.

Though we have already hinted at some methodological assumptions, it would be worthwhile to spend more attention to methodology.

4. Methodological Approach

The research design collects (partly) empirical data that can be compared, i.e. two 45-minute lessons that have been conducted in different countries with rather different socio-cultural settings and backgrounds. So far, only a few, if any, empirically tested and theoretically sound modules for ESD have been designed and tested.

The teaching concept for our P4C was designed for one double period (90 minutes) or two single periods (45 minutes each), but it is expandable to up to three or four periods without the need for further teaching materials. The concept was tested in several different primary schools in Sachunterricht of Year 3.

In an introductory session, the pupils looked at and described disparate photo pairs showing the same natural motif (littered nature vs. unspoiled nature; see *Appendix: Photos that have been presented to pupils*) and, while intensively talking about their emotions[9] when looking at these contrastive pictures, were sensitized about the issue of pollution. The teacher does not steer the pupils, and it is expected that, while talking about their feelings, the pupils develop the idea that pollution is manmade. Based on this, the pupils compose a letter from the perspective of the animals suffering on account of the pollution caused by humans. At this point, the pupils have to leave a supposedly egoistic perspective behind

[9] The idea of talking about their feelings with pupils is supposed to fulfil several functions. First, there is often no time for feelings in the daily school routine despite the fact that there are many situations that can cause pupils to become emotional and might require a conversation about their feelings, especially if those conversations about feelings would influence teaching more positively than negatively. This desire would, therefore, be fulfilled. Second, the affective stimulation of the pupils, hopefully, leads to a certain passion that influences the following serious discussion. Third, the inclusion of feelings leads to a direct comparison of emotional argumentation (first period) and—in the best case—rational argumentation (second period), which is one of our main theses.

and adopt an allocentric perspective. Hence, sustainability-relevant, moral educational processes are already initiated.

This forms the foundation for a SC in the following period. The topic of pollution, technically, was not chosen by the pupils but, after being sensitized about it in the introductory session, it became an issue relevant to their own life worlds and, so, they want to talk about it in more detail. During the serious discussion, the pupils mainly deal with three questions: i) Why do I feel bad when I see pollution and suffering animals? ii) Should people be punished when they leave rubbish at the beach or in the forest? If so: how severe should the punishment be? iii) People, too, suffer from pollution. Is it worse when humans become ill from rubbish, or is it just as bad when animals become ill and die?

Some hints for teachers can be summarized as follows:

- Try to create an atmosphere where pupils really express what *they* feel and what *they* think, and not what they think the teacher would like to hear.

- With respect to the task "What do I feel when I am looking at the photos?" keep in mind that there is nothing wrong with children's feelings. They do not need to feel sad, disturbed, and distressed or the like when they are looking at the polluted environment! As regards this task, there are no wrong answers!

- Pupils should not be guided more than it is necessary to promote and provoke their own thoughts. Do not insinuate children's thoughts and do not presume a "normal" or "standard" answer to any question.

- P4C takes time and it does not matter much if you are not able to finish all five tasks within 90 minutes. Do not rush through the lesson!

- Against some theoreticians (and practitioners): Teachers do not need a very long special training in guiding SC, but you have to be prepared, e.g.: Prepare questions that enable one to understand better what pupils think; Moreover, prepare for some pedagogical disappointment! (Some pupils are not able or willing to justify their statements and simply do not want to engage in P4C.)

5. Results

So far, from 2016 to 2019, the lessons (two lessons over 45 minutes) have been conducted with 206 children.[10] Nine primary schools in five countries located in four continents have participated: a) Germany (76 third-grade pupils, 26 sixth-grade pupils), Brazil (66 third-grade pupils, c) Argentina, d) South Korea and e) Tunisia (approx. 20 pupils each).

We will first argue that there are, in fact, intercultural similarities, a kind of overlapping consensus as regards moral thinking of children (Section 5.1). Section 5.2 deals with some manifest intercultural differences. Owing to the restricted space, we restrict ourselves to only a few interpretative remarks that try to explain differences as well as similarities in Chapter 6. Furthermore, we will omit the answer to Question 1 (What do I see?) and Question 2 (What do I feel?) and we will not interpret results of the letters (see Ch. 6; task: Write a letter to mankind from the perspective of your favourite animal!).

[10] It is beyond the scope of this contribution to deliver an in-depth analysis of all the results. We are still interpreting some translations (especially from Arabic, South Korean, and Portuguese into German). One of the challenges that translations display is whether, and in which respects, some world-views are at all comparable.

5.1 Intercultural similarities

The following results should certainly be discussed in more detail. Since we are still evaluating some of the results and we have to restrict ourselves to brevity, we have to condone a rather sketchy account.

Question 3: Why do I feel bad (if I am feeling bad) when I see pollution and suffering animals?

First, teachers should not manipulate or overwhelm pupils with an attitude that suggests that it is "normal" or even morally valuable, to feel bad. In fact, not every pupil actually feels bad looking at Pictures 2 and 4. Very few pupils answered that spoiled nature reminds them that it looks like their homes, and is, therefore, a familiar sight.

Second, complex opinions arose: Pupils are cross-culturally concerned and worried about pollution and its effects on animals. They express their worriedness and sadness.

Question 4: Should people be punished when they leave rubbish at the beach or in the forest? If so: How severe should the punishment be?

The only common denominator is that all pupils without any exceptions state that there should be some punishment. Apart from this view, we figured out a wide spectrum of answers.

Question 5: People, too, suffer from pollution. Is it worse when humans become ill from rubbish or is it just as bad when animals become ill and die?

Overall, most pupils agree that it is at least as bad when animals suffer, but we found great intercultural differences (see Section 5.2).

5.2 Intercultural differences

Question 3: Why do I feel bad (or not bad) when I see pollution and suffering animals?

Three quite original rationales are: “Because we human beings produced all the garbage and we have also disposed it illegally” (German pupil). “The animals are very miserable [their situation is miserable; TS] and there is also guilt of human beings; so, my heart is aching” (South Korean pupil). “Because it is sad and they [the animals; TS] can die or feel ill.” (Brazilian pupil)

Question 4: Should people be punished when they leave rubbish at the beach or in the forest? If so, how severe should the punishment be?

The answers offer a variety of perspectives, depending on the socio-cultural setting. **A)** In Germany, 33% opt for imprisonment, and 18% suggest that polluters should change roles with animals which suffer from pollution for educational purposes or for reasons of compensation. Some original answers are: “They [the polluters; TS] should collect all the rubbish and change [places] with animals.’ ‘The animals should throw all the garbage on the polluters, so that humans can see what they do.” **B)** In South Korea, all pupils argue that penalties (ranging from 80 euros to more than one million euros) are the appropriate punishment; pollution is ethically bad behaviour. The most original answer is: “When you have to pay a lot of money, then you won’t continue polluting the environment.” **C)** Brazilian children did not opt for a penalty fee at all (the idea of punishment, especially penalty fees, seems to be a kind of taboo.) Rather, they support compensation, e.g. removal of garbage. 25% of the Brazilian pupils suggested feeding the piranhas! **D)** In Argentina, 53% of all pupils prefer as punishment collecting garbage. Some pupils do not shy away from rather cruel physical punishment and even did not rule out the death penalty; finally, they crossed out this radical answer; **E)** In Tunisia, pupils

propose a wide range of punishment, such as penalty fees, imprisonment, removal of garbage and again—changing the roles—so that polluters have to themselves live in the polluted environment.

Question 5: People, too, suffer from pollution. Is it worse when humans become ill from rubbish, or is it just as bad when animals become ill and die?

In Argentina, Brazil, Germany, and Tunisia, an overwhelming majority (ca. 90%) argues that it is as bad if animals suffer from pollution, because animals can suffer in a manner similar to humans, but, unlike humans, they cannot consult physicians. A few German pupils argued that humans have a kind of responsibility towards animals because they caused pollution. In South Korea, pupils also argued that humans and animals are both living creatures and, therefore, are all equally important. Only two pupils argued that pollution effects are worse for animals than humans because, in contrast to innocent animals, humans could reflect on their actions. Brazilian pupils argued differently: More than 50% think that it is worse for human beings that other human beings to suffer from pollution. We are still looking for a more or less sound interpretation of this result.

6. Interpretation and Outlook

We think that third-grade pupils already have an interculturally tested ability of moral thinking—more precisely, they are able to adopt a vulnerabilistic and pathocentric perspective, i.e. overcome purely egoistic-subjective perspectives. This interpretation requires a further explanation. It is without doubt relevant to distinguish e.g. the pupils *wish* that animals shall be protected (because they are more or less tiny creatures, esp. pets) from pupils' willingness and ability to *argue* against pollution, i.e. more than simply to repeat expressions of subjective emotions or subjective attitudes towards nature? Pupils in South Korea seem to be aware that garbage causes enduring environmental problems. Some of

the pupils hold the view that animals are important beings and that there is an ecologically funded interdependence of human beings and animals. Some pupils are able to change perspectives and have a basic understanding of reciprocity in terms of interdependency of human and animal co-existence and in terms of holding a mirror up to human beings. Another intriguing question is whether pupils are capable of formulating universalization of views and leaving the egoistic position. We have to concede that only few—though anyway—some pupils diagnose a correlation between disappearance of animals and its impact on life in general: animals. Instead of arguments that are definitely universal, most pupils use lots of implicit arguments, i.e. with tacitly assumed premises.

Certainly, the pictures had a suggestive force, but they are necessary, for pragmatic reasons, to initiate children's feelings and thinking processes. We should keep in mind that the lesson can be easily adjusted worldwide without intensive technical equipment and is a starting point for a teaching unit plan with respect to ESD and moral thinking that is currently being designed. Our pupils are certainly the "main actors". Hence, with their letters, they will have the final say:

- "When we go on polluting our environment, someday we will get rubbish out of our water-tap instead of water." (German pupil).

- "I would like to say to those who simply throw their garbage away: Don't throw garbage into our beautiful nature! Animals suffer from the disgusting stench and they have to grow up in an environment full of disgusting stench! Animals are living creatures!" (Pupil from Tunisia).

- "I am a white shark […] I will make a reservation for fish where there is nothing foul and I will remove everything that is bad for fish, whales, sharks, seals, and turtles. I will

start a business for animals, sell it, and will make a lot of money to pay persons who take care of animals" (Brazilian pupil).

- "I am a tiger and I live in the forest […] Both the places—the sea and the forest—are very polluted. Our species is in a dangerous situation because we are threatened with extinction. What will you do if our den is polluted with garbage? When you remove it, our den will be a convenient place. Someday in the future we cannot live in the sea or in the forest. Then there will be no fish and other animals for you to catch." (Pupil from South Korea).

- "I am a cook: I tell you, stop throwing garbage out of your house, because you do not want someone else to throw garbage into your house." (Pupil from Argentina).

Appendix: Photos that have been presented to pupils

Fig. 1: Fernando De Noronha 2011
(Source: iStock-licence; https://www.istockphoto.com/de/foto/brasilianischen-strand-bahia-do-sancho-fernando-noronha-gm529177045-53895198?esource=SEO_GIS_CDN_Redirect (image rights have been purchased)).

Fig. 2: Koh Phi Phi 2015
(Source: iStock-licence; https://www.istockphoto.com/de/foto/tarutao-national-park-thailand-gm628738262-111693715 (image rights have been purchased)).

Fig. 3: Location unknown 2014
(Source: Pixabay, https://pixabay.com/de/photos/hirsch-damhirsch-geweih-wald-1766113/ (photo is in public domain)).

Fig. 4: Yunnan 2013, Photo: Herbert Rulf
(Source: http://www.geo.de/reisen/community/bild/608939/Yunnan-China-Wo-sind-die-Gaense#gallerySlider (photo is in public domain)).

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POSTERS

André Dorn, Martin Gröger

ESD in general studies - prospective general studies teachers deal with the educational concept of ESD in a student-oriented and cooperative manner

With the increasing ecological, economic, social and cultural challenges that we are facing worldwide in the 21st century, the concept of sustainable development plays an increasing important role. Not only since Agenda 21 has education been assigned a decisive key position in the process of sustainable development, because sustainable development cannot be guaranteed without a global educational initiative. However, university courses concerned with the concept of education for sustainable development still play a subordinate role in teacher training. Since the last teacher training reform in 2009, the University of Siegen has offered students of general studies the option of an in-depth module (in-depth studies) which focuses on aspects of sustainable development and education for sustainable development.

This study examines the extent to which the professional attitudes, needs and concerns of future teachers of general studies (science and social studies at primary school level) with regard to Education for Sustainable Development (ESD) develop during the in-depth module. The study is based on the Concern-Based Adaptation Model (CBAM) with the diagnostic dimension Stages of Concern (SoC) by Hall and Hord (2011).

The effectiveness and changes of the in-depth studies are tested in an accompanying study with 109 students of general studies within the framework of a comparison group design, whereby 42 students took the in-depth studies for general studies.

The results indicate a clear development and change in the students' attitudes, their orientation towards pupils, their cooperation and acceptance of the educational concept of Education for

Sustainable Development. The in-depth studies program has evidently succeeded in exerting a positive influence on the professional attitudes of future teachers.

1. Introduction

Against the backdrop of global ecological, economic, social and cultural challenges, the educational concept of Education for Sustainable Development describes a possible way to advance social transformation (see Rieckmann 2016a, p. 11). In this context, education for sustainable development aims to enable people to participate in society's learning and communication processes for sustainable development and to prepare them for an as active participation as possible in the "Great Transformation" (WBGU - German Advisory Council on Global Change 2011). However, specific learning and educational processes must be developed for this purpose (see Vare and Scott 2007, p. 192). For example, the UN World Decade of Education for Sustainable Development attempted to anchor the guiding principle of sustainable development in all areas of education so that it would become a self-evident component of a future-oriented education. However, "the decisive steps towards implementation in the structures and day-to-day life of the education system are still ahead of us" (Haan 2015, p. 16). This is an area in which also universities have to become more active, particularly in teacher training because this is considered to play a decisive role in implementing Education for Sustainable Development in the school context (see Hellberg-Rode and Schrüfer 2016, p. 1).

Attitudes towards the development of innovations - such as Education for Sustainable Development - are particularly central to successful implementation in schools and a successful realisation (see Schneider et al. 2013, p. 197).

So far, however, courses of study concerned with Education for Sustainable Development only play a subordinate role in teacher training. They are mostly based on the commitment of individual

actors or institutions (see Hauenschild and Rode 2013, p. 78; Hellberg-Rode and Schrüfer 2016, p. 1 f.).

Scientific studies on this aspect also remain a desideratum (see Adomßent and Henze 2013; Hauenschild and Rode 2013). According to Hauenschild and Rode (2013), although sufficient conceptual and didactic-methodological foundations already exist that can support the dissemination of ESD and its implementation in schools, there is a lack of empirical research on the implementation of ESD and, in particular, on the mechanisms that could promote this innovation. Moreover, there is still a lack of a deeper integration of ESD in teacher training (see Hauenschild and Rode 2013, p. 78).

At the University of Siegen, the introduction of renewed courses of study has provided an opportunity to accompany the implementation of a study programme on sustainability in teacher training in this sense and to examine attitudes and their changes within the framework of an accompanying study on in-depth studies among prospective teachers of general studies.

2. Theoretical foundations

The Concern-Based Adoption Model (CBAM) by Hall and Hord (2011) was selected to capture the perspectives of prospective teachers and their acceptance of the educational innovation described above. With the help of the diagnostic dimension Stages of Concern (SoC) from this process- and stage-model, it is possible to examine the attitudes, needs and concerns of individuals with regard to the educational concept of Education for Sustainable Development and to trace the development of changes in attitudes (see Bolte et al. 2014, p. 426). According to Hall and Hord (2011), teachers go through seven different Stages of Concern (SoC) during an instructional innovation. At the first stage (SoC-0: "Unconcerned") teachers have little or no contact with the innovation and are hardly motivated to deal with it. This is followed by a level

(SoC-1: "Informational"), in which there is an interest in basic information. The next level (SoC-2: "Personal") deals with the possible educational and personal consequences that could result from the innovation or change the own role as a teacher. This is followed by a third level (SoC-3: "Management"), which focuses on organisational tasks and requirements, e.g. how the preparation of lessons changes because of the innovation. At level four (SoC-4: "Consequence") the focus is on positive or negative effects on pupils and how they think about it, followed by a level (SoC-5: "Collaboration") in which the emphasis is on the desire for cooperation among participants. The last level (SoC-6: "Refocusing") refers to the further development and optimisation of the innovation.

The SoC model also has the advantage of revealing characteristic attitude profiles of the participants – so called SoC profiles - such as co-operators, opponents or non-users of the innovation. These profiles also provide information on the extent to which acceptance of and professional attitudes towards Education for Sustainable Development develop during the course of the prospective teachers of general studies (see Bitan-Friedlander, Dreyus and Milgrom 2004). An intervention study with a comparative group design and data collected at several different points in time is particularly suitable for such an assessment of effectiveness and change.

3. In-depth studies for students of general studies

At the University of Siegen, the introduction of new courses of study has provided an opportunity to provide scientific support for the implementation of a course of study on sustainability in teacher training. Since the last reform of teacher training in 2009, students in the bachelor's programme have the option of choosing a four-semester in-depth module concerned with the Education for Sustainable Development educational concept. This so-called in-depth study program includes four cross-disciplinary courses that focus on aspects of sustainable development and education

for sustainable development (ESD) (see Figure 1). Here, students learn in a special way about the integrative approach of general studies on the one hand and the networked and complex thinking of Education for Sustainable Development on the other (see Universität Siegen 2011, 377 ff.).

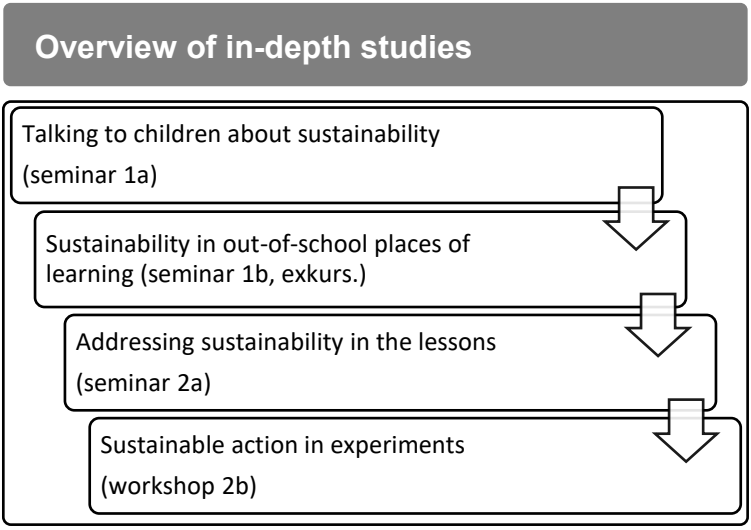

Figure 1: Overview of in-depth studies for general studies

This provided a great opportunity to survey the perspectives of prospective teachers of general studies during their studies in sustainable development with a scientific accompanying study. The research focus was on the prevailing attitudes, needs and concerns of prospective teachers with regard to ESD, which are seen as decisive factors for later actual implementation in schools (see Schneider et al. 2013, p. 197).

4. Study design

The accompanying study first focused on the acceptance of Education for Sustainable Development during the course of general studies in order to gain an insight into the prevailing attitudes,

knowledge, needs and concerns of the prospective teachers with regard to ESD, as these appear relevant for possible later implementation in schools. Furthermore, changes and effects caused through participation in the in-depth study in general studies should be assessed. The guiding questions were as follows:

- What professional attitudes, knowledge, concerns and needs do the prospective teachers of general studies have with respect to the Education for Sustainable Development educational concept?

- How do the attitudes of prospective subject teachers toward ESD change in the course of participation in the optional in-depth study program focusing on ESD?

To answer these questions, the Concern-Based Adoption Model (CBAM) by Hall and Hord (2011) was selected as the research approach in this study. The diagnostic dimension Stages of Concern (SoC) was used to determine the degree of conflict with ESD. The Stages of Concern were surveyed specifically with a questionnaire adapted to the clientele and the issue at hand. A subsequent communicative validation was intended to support the interpretation of the SoC profile types on the one hand and to check the application of the diagnostic dimension Stages of Concern of the CBAM to the study group of students on the other hand.

The study was carried out in three consecutive years with a total of 109 students of general studies as an intervention study in a comparative group design with two survey dates, one at the beginning and one after the participation in the in-depth studies. 42 students underwent the in-depth study as an intervention group, while 67 students who had chosen their in-depth studies in other learning areas formed the control group. The study comprises three entire cohorts of students, which were combined in a cohort analysis.

5. Results

The results show that, with regard to the survey on the educational concept of ESD in the pre-test, the interviewed students of the intervention and control group are almost at the same level with regard to the entry requirements (see Figure 2).

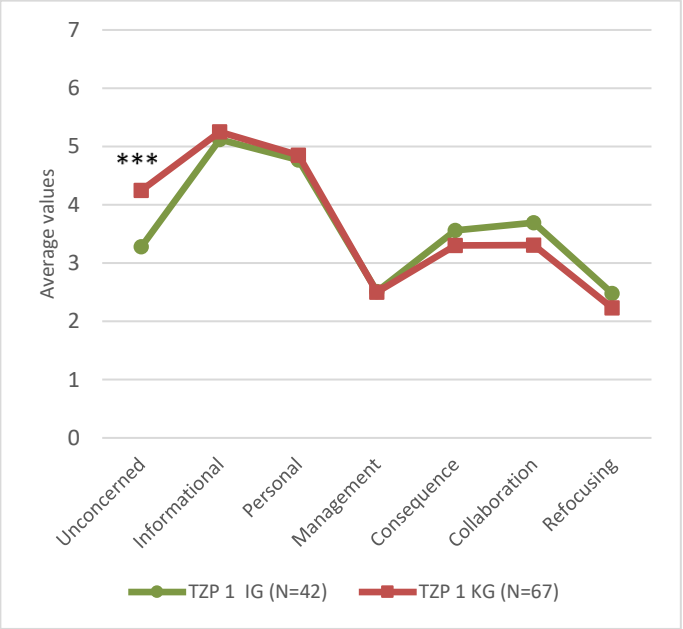

Figure 2: SoC profiles in the pre-test (IG: intervention group, KG: control group)

Evaluating the attitude patterns, represented in the study by the profiles of the SoC interest categories, a great need for basic and general information on the educational concept of Education for Sustainable Development (SoC 1 - informational) and a pronounced openness towards ESD can be observed among the students. The students show a high level of concern and are already thinking about the impact of implementing ESD in everyday school life. In this early phase the personal interest categories (personal concerns) generally dominate, while the task and impact-related

adaptation levels (task and impact-related concerns) are not very pronounced. Students state that they are not informed about the innovation of ESD before the in-depth studies in the Bachelor's programme and would like to learn more about it. However, the intervention group in the first category is characterised by the fact that the students have already dealt with sustainable issues earlier and/or are more interested in ESD than the control group.

The results of the post-test indicate that the in-depth studies in general studies have a clear influence on the Stages of Concern and the related professional attitudes (see Figure 3).

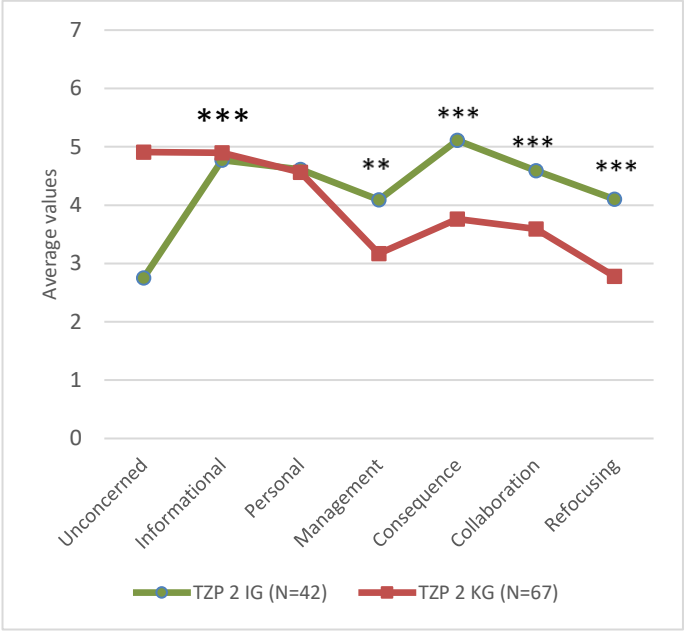

Figure 3: SoC profiles in the post-test (IG: intervention group, KG: control group)

After completing their in-depth studies, the students in the intervention group show a clear increase and shift of personal concerns towards task- and impact-related interest categories. The

differences are significant with moderate effect strengths. These students can therefore be described as "users" of the innovation.

The changed SoC profiles and the changed attitude patterns of the intervention group show the students' increased involvement with the educational concept during their in-depth studies and also their great interest in ESD. In comparison to the beginning of the in-depth studies, the students' need for information (SoC 1) and personal involvement (SoC 2) is still high at the end of the in-depth studies, and these have not changed noticeably because of the studies. Overall, the intervention group attributes a high degree of importance of ESD for lessons they will give in the future. They are very interested in how they will deal with the demands placed on them later in their careers (SoC 3). Similarly, as an expression of a stronger pupil orientation, the importance and interest in how Education for Sustainable Development is received by pupils and what effect it has on them has also increased considerably.

Moreover, these students have a strong need to work together with others and see cooperation with colleagues as a prerequisite for a successful implementation of ESD in schools (SoC 5). The students have learned more about how to improve ESD implementation in class (SoC 6). Accordingly, the investigation of the SoC profiles showed that they could be classified as "pupil-oriented cooperation facilitators".

In contrast, the characteristics of the SoC interests and the profiles of the non-user have remained almost constant. Thus, the profiles of the control group differ significantly from that of the intervention group in several SoC interest categories. The focus in the control group continues to be on the personal concerns. Thus, the students can be described as non-users in both the pre-test and the post-test. It can therefore be assumed that the students in the control group have not dealt with the educational concept of ESD in other university courses and, under these circumstances, are very unlikely to implement the educational concept in future

lessons and at school. Nevertheless, according to the data available, the students can at least be described as interested and open-minded towards ESD. The decisive factor here is whether this picture can be changed positively through further courses or later through teacher training.

An additional communicative validation, which served to sharpen the identified SoC profiles, also confirms the classification of the intervention group as "users" and "student-oriented cooperates".

6. Summary

It can be seen that the in-depth studies in the learning area of general studies at the University of Siegen have apparently succeeded in positively influencing the professional attitudes of the prospective teachers of general studies towards the educational concept of Education for Sustainable Development. The in-depth module thus offers an opportunity to anchor education for sustainable development in the structure of the educational system at the university and to link it with general studies. In addition, it creates favourable conditions for carrying ESD into schools and lessons.

Students attending in-depth studies of general studies can be attested that they presumably deal with the requirements and tasks in the context of Education for Sustainable Development in a more open and informed manner. There is a fundamental desire among them for joint implementation and cooperative exchange with regard to ESD and teaching. This willingness is a crucial factor in implementing ESD in schools.

With regard to the "Stages of Concern" model, it must be noted that although it provides important indications of innovation-related acceptance for the description and analysis of individual development processes, this limited consideration of the affective-cognitive aspects is not sufficient to make predictions about the actual implementation and application of education for sustainable development in the classroom. The extent to which future

behavioural patterns could actually be influenced and how the educational concept of education for sustainable development actually will play a role and be implemented in general studies taught by the future teachers could be analysed in detail in further studies.

Further goals and demands derived from the results of this work include not only expanding and stabilising the guiding concept of Education for Sustainable Development in the university teacher training phase but also advancing support for the implementation of ESD in in-service and continuing teacher training (see Overwien 2016). Here, the focus should first be on the results of the control group. The students in this group can be described as "non-users". This clearly shows: If teachers have a key role to play in implementing Education for Sustainable Development, then Education for Sustainable Development should be anchored in the entire structure of teacher training. Thus, educational processes and institutions can be shaped and redesigned in a way that is future-oriented. In other words, Education for Sustainable Development should not be limited to in-depth studies in general studies but should be implemented integrally for all students of general studies.

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[11] Sachunterricht is a subject in primary school comprising natural and social science-oriented areas of learning and called "general studies" in this article.

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Andree Georg

From Carlowitz to Sustainable Development and Education for Sustainable Development

Sustainable development is a commonly used term. The paper outlines the development of the term based on sustainability in Germany. Sustainable development is part of teacher education at the University of Siegen. A survey shows the importance of sustainability for students as well as their willingness to accept personal restrictions for sustainable action.

1. Sustainable Development

In 1972 “The Limits to Growth” was published, sustainability became popular and was more focused on ecological aspects. Dennis Meadows and his team tried to give a prediction about the development e.g. of the population, nutrition, energy supply, raw material and environmental pollution until the year 2100. The report predicted a meltdown of the industrial society and Meadows demanded a change to prevent an ecological collapse.

The World Commission on Environment and Development was established in 1983 to work on an environmentally friendly development to the year 2000. In 1987 the report “Our Common Future” was published, including a new combination of sustainability and development:

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.''

It is the classic and maybe most famous definition of sustainable development, which is used today.[12]

In the end it was a long progress from Carlowitz idea of sustainability to the modern sustainable development. Sometimes this wide spread sense of sustainability can lead to a misunderstanding, so it is useful to look back to the roots. (cf. Pufé 2017, 37-55)

2. H. C. von Carlowitz and sustainability of the forests

In 1713 Hans Carl von Carlowitz created the German term and gave the first definition of sustainability of forestry, which is known as “Nachhaltigkeit” in Germany. More than 300 years later and the term “Nachhaltigkeit” became popular in different ways, especially in the last fifty years.

Figure 1: Hans Carl von Carlowitz
Source: https://commons.wikimedia.org/wiki/File:Hans_Carl_von_Carlowitz.jpg

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(https://www.nachhaltigkeit.info/artikel/erste_verwendung_durch_die_vereinten_nationen_1728.htm)

H. C. von Carlowitz was born in 1645, later he studied law at the University of Jena and became a member of the administration of Saxony. In 1677 at the age of 32 von Carlowitz was promoted to the second highest position in the administration of mining to take care of the biggest problem then, the lack of timber. Forest depletion was typical for mining areas, because a lot of timber was needed for construction under the ground. Timber was carbonized to charcoal to smelt iron or other metals out of ore. Without timber it was impossible to run a mine or a smelting work and Saxony was in danger to lose a big part of its income.

At this time forest science was not established, so it was not uncommon to solve the problem of the lack of timber by a lawyer. H. C. von Carlowitz was prepared for this job with some knowledge about forestry, because his father worked in the forest administration. After his studies in Jena he made a journey to England and France where people were dealing with the same problem. At that time, wood was the universal building material and source of energy. The forests were devastated due to the high demand for wood. (cf. Grober 2013, 112-120)

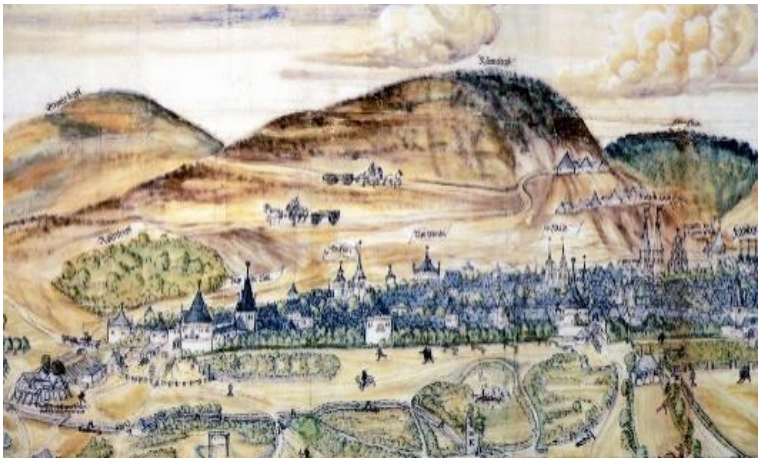

Figure 2: Bildkarte von Goslar und dem Rammelsberg, Matz Sincken (1574)
Source: https://commons.wikimedia.org/w/index.php?curid=27319833

3. „Silvicultura oeconomica“

In 1713 H. C. von Carlowitz published “Silvicultura oeconomica”, the first German comprehensive book about forestry. It contains a description of different tree species, how to seed or plant trees and forest damages. There are also instructions to save wood and to cultivate the forests.

Von Carlowitz demands a permanent control of extraction of timber, without damaging the forests to keep them in a stable condition. His idea was based on the lack of timber for construction and energy source as well as on responsibility for the next generations.

Figure 3: Silvicultura oeconomica, Carlowitz 1713
Source: https://commons.wikimedia.org/wiki/File:Carlowitz_Sylvicultura.jpg?uselang=de

The Sustainability ("Nachhaltigkeit") in the management of forests was characterized and so von Carlowitz founded the German term of sustainability. In a modern way it can be described as follows: a renewable resource should not be used more than its natural regeneration to sustain the renewable resource. This implies the fact that not renewable resources must not be used in a sustainable way.

Since the beginning of the 19th century, sustainability was part of the discussion in forest sciences but economic aspects became more important. The growth of the forests was no longer key to sustainability as the return on equity capital. On the other side the German encyclopedia "Brockhaus' Konversations-Lexikon" (1901) still did not contain an entry of "Nachhaltigkeit" (sustainability). (cf. Bendix und Thomasius 2013, 84-85; cf. Huss und von Gadow 2012, 27-29, 46-50)

4. Education for Sustainable development

Sustainable development is an essential part of the General Studies (Sachunterricht) at the University of Siegen, where Primary school teachers are educated in natural and social sciences. Some students (n=73) have been asked at the beginning of their studies to proof their ideas about "Nachhaltigkeit".

a. What does Nachhaltigkeit (sustainability) mean for you?

Most people are connecting environmental protection with Nachhaltigkeit (18%). Even the protection of resources is important for the students (16%). Socials aspects (10%) and the responsibility to next generations (13%) take a bigger part in understanding of Nachhaltigkeit.

b. Are you ready to accept personal restrictions for sustainable action?

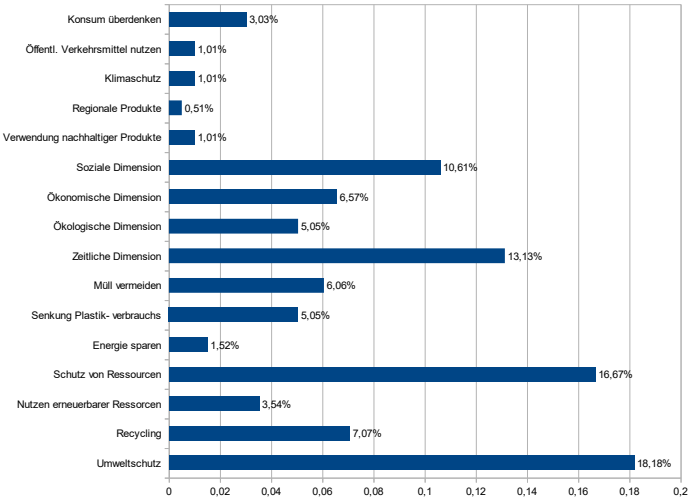

Diagram 1: What does Nachhaltigkeit (sustainability) mean for you?
(Source: Own survey)

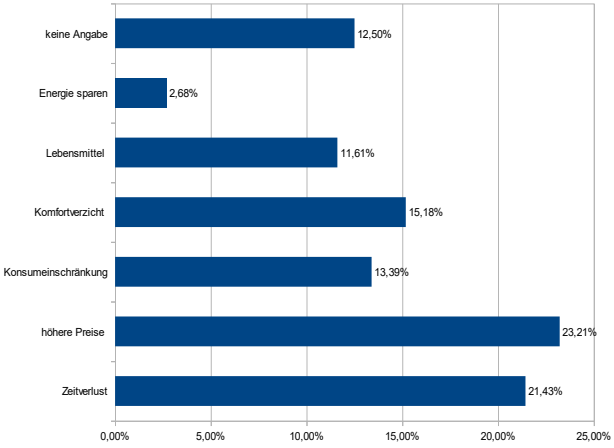

Diagram 2: Are you ready to accept personal restrictions for sustainable action?
(Source: Own survey)

Many students would spend more money (23%) or more time (21%) to act sustainably. Others would agree to less comfortable ways of living (15%). It is remarkable that 12% did not answer the question probably because they did not understand the question or they have not made their mind up yet.

5. Summary

In the German-speaking area, the term sustainability goes back over 300 years linked with forestry. Due to the high demand, no more wood should be used than grows back. This should secure the sustainable resource wood. With the report "Our Common Future" the term sustainability became known in 1987 and expanded to include the aspect of development. Since then, the term sustainable development has been used a lot without being clearly defined. This can also be seen in the broad understanding among teaching students at the University of Siegen. However, many students are willing to accept personal restrictions for sustainable development.

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Irina Landrock

Children at NS Memorial Sites

This article offers a brief presentation of an ongoing ethnographic dissertation project that examines pedagogical practice in education work with children at NS memorial sites from a practice theory perspective. By giving an exploratory description of such specific learning locations and settings, the project aims to enrich the discourse on out-of-school learning with special reference to the didactics of 'Sachunterricht'[13]. Thus, the project is located in the field of primary school research, but also aims to merge the discourses of primary school pedagogy and memorial site pedagogy on an empirical basis.

1. Introduction

In the Federal Republic of Germany, the remembrance of the National Socialism (NS) past is part of a democratic self-conception (cf., e.g., Messerschmidt 2018). Such remembrance is regularly subject of historical-political education in schools and at NS memorial sites, which are given an *outstanding significance as places of learning*[14] (cf. Deutscher Bundestag, 2008: 2). These *authentic places* (cf., ibd.: 3), which are issued with the mission to promote fundamental principles of democratic order such as respect for human dignity, awareness of the importance of freedom and the binding of values of the Basic Law (cf., ibd.: 1), are assumed to be highly effective for the so-called learning from history. Thus,

[13] 'Sachunterricht' is a German school subject in primary schools, which could be translated into *elementary science education*. It considers aspects of social sciences including geography and history as well as nature sciences (such as biology, chemistry and physics) in a cross-perspective manner. 'Sachunterricht' aims to fulfill a dual connection task regarding children's learning conditions and interests on the one hand and the subjects offered in secondary schools on the other hand.

[14] For a better readability all German quotations have been translated directly into English by the author. However, to mark them as quotations they are set in italics.

educational offers at NS memorial sites are demanded and supported by education policy, e.g. with the current program "Jugend erinnert" [youth remembers, I.L.] (BMFSFJ & Auswärtiges Amt 2019). Apart from this political demand, literature on pedagogical practice in NS memorial sites indicates that, in addition to adolescents and adults, even children of primary school age are increasingly being addressed with specific education offers (cf. Gabriel 2018).

However, social expectations and political ambitions which are combined with the *pedagogization of the remembrance culture* (cf. Meseth 2007) are countered by the fact that the concrete practice of education work at NS memorial sites has hardly been empirically examined, so far; this applies in particular to pedagogical work with children. What happens in NS memorial sites in practice of pedagogical education work with children of primary school age? Which contents become relevant? How are they negotiated? What importance is attached to the specific place and the things in that place? How and as what are the children addressed? These questions will be examined in the dissertation project 'Children at National Socialism Memorial Sites'[15], which is to be presented in the following.

First, I will briefly describe the constitution of NS memorials sites in Germany including their main functions and tasks ascribed. Then follows an insight into the state of research regarding the practice of education work with adolescents in NS memorial sites as well as the learning conditions of children in dealing with

[15] This research project initiated by Prof. Dr. Alexandra Flügel is located in the department of primary school pedagogy of the University of Siegen. It is embedded in the major project 'Den Sachunterricht vernetzen – Perspektiven öffnen' [Networking elementary science education – widening perspectives, I.L.]. The transdisciplinary project financially supported by the North Rhine-Westphalian ministry of innovation, science and research seeks to expand the didactics of 'Sachunterricht' and to promote young academics.

aspects of NS past in primary school lessons. These points of reference shall serve as a comparative template, due to the lack of former research activities examining children at NS memorial sites. Next, I will explain the research design considering methodical and methodological reflections. Since this article describes an ongoing research project, I will refrain from presenting results[16], but will instead conclude by portraying the goals of the research project and its potential contributions to the discourse on out-of-school learning with special reference to the didactics of 'Sachunterricht'.

2. German NS Memorial Sites and their constitution

In Germany, NS memorial sites are generally located in places of historical events strongly connected to the era of National Socialism and its crimes, where victims suffered or have been martyred (cf. Knigge 2004), e.g. concentration or labour camps, euthanasia institutes or places of former legal authorities of the NS regime[17]. Knigge (2004) describes them as ambiguous palimpsests. According to him they can be seen as graveyards and political monuments that become places for individual and collective projections (cf. ibd.). As places of certain historical events, NS memorial sites obtain multiple functions or tasks: research and documentation of the concrete place's history, remembrance of the NS past and commemoration of its victims, information about or rather impartment of NS history plus historical and political education (cf. e.g. Haug 2015, 114). Alltogether, NS memorial sites aim to combine a *retrospective and a prospective function* (c.f. Siebeck 2010: 177) as their specific past is made socially relevant and marked as *identity-forming and action-guiding for present and future* (c.f. ibd.). Although this normative goal has to be questioned, as there

[16] First impressions of the field can be taken from the following articles, for instance: Flügel & Landrock (2020, 2019), Flügel (2020) or Landrock (2020).

[17] A list of German NS memorial sites is presented on https://www.gedenkstaetten-uebersicht.de/europa/cl/deutschland/.

is no theoretical or empirical proof for the causal link between history knowledge and moral-political action (cf., e.g. Haug 2015: 50), NS memorial sites can be regarded as independent education institutions, which are given the task by education policy to impart political lessons from NS history in cooperation with schools (cf. Deutscher Bundestag, 2008: 1). Therefore, NS memorial sites are given an *outstanding significance as places of learning* (cf. ibd.: 2).

3. State of Research

Connected to the expansion and professionalization of education offers and activities at NS memorial sites in the past decades, a subdiscipline of education science called 'Gedenkstättenpädagogik' [memorial site pedagogy, I.L.] has emerged in Germany (cf. Eckmann & Österberg 2017:49) and with it a field of research which "covers different areas such as analyses of the exhibitions and educational activities at the sites; studies of peoples' expectations before a visit and/or experiences or recollections of visits; attempts to measure the effects of visits; and analyses of visitors' socio-demographic composition" (cf. ibd.). The dissertations of Gudehus (2006) and Haug (2015) can be mentioned as essential German studies[18] on the practice of educational activities at NS

[18] In a meta-study initiated by the International Holocaust Remembrance Alliance (IHRA 2017) it is pointed out that most discourses in the context of Teaching and Learning about the Holocaust take place within linguistic or regional communities rather than between them (cf. Eckmann & Stevick 2017: 25). This is due to the fact that Teaching and Learning about the Holocaust is embedded in specific historical, geographical and cultural contexts, making it difficult, if not impossible, to generate universally valid statements (cf. ibid., p. 28). Particularly the German research community rather prefers dealing with German literature (cf. Eckmann & Österberg 2017: 37). But even within the German linguistic community, remembrance discourses differ, for example, in the perpetrator nation Germany and the rather neutral nation Switzerland (cf. ibd.). Differences also apply to the terminology, e.g. regarding the use of the term 'Holocaust' (cf. ibd.). In contrast to the rather narrow definition of the Stockholm Declaration (cf. IHRA 2017: 9f.) to which the IHRA refers, the Holocaust is embedded into a more general context of National Socialism in German discourses (cf. ibd.). Accordingly, the term 'National Socialism' (NS) is used here to refer to this epoch-making ideology including all its mass crimes.

memorial sites. In both, the practice of pedagogical work with adolescents is observed in situ.

Although there is yet no empirically based knowledge of how children deal with the history of the NS regime in the context of pedagogical offers and activities at NS memorial sites, there are some studies on how the subject is dealt with in primary school lessons. In this respect, there are some basic topic-related insights into learning conditions of children of primary school age and their mental (re-)presentations of NS history.

3.1 Practice of education work with adolescents at NS memorial sites

An analysis of the communication in education work with adolescents at NS memorial sites shows that a consensus on the moral evaluation of NS is insinuated even before the topic itself is broached; in this respect it is assumed that young people have previous knowledge on NS and especially on its social significance (cf. Gudehus 2006: 288). In the communicative treatment of the topic, an introduction and rehearsal of appropriate speaking becomes apparent which seems like a *preparation of speaking* (cf. Haug 2015: 288). In guided tours, for example, this is converted through exemplary speech offered for imitation (cf. Gudehus 2006: 25ff.). Thus, the thematic treatment of the NS can sometimes become distorted by the inherent logic of *pedagogical event forms such as guided memorial site tours* (cf. Meseth & Proske 2013: 7).

The staff of NS memorial sites are also faced with the specific challenge of meeting the current needs of the participants on the one hand, and of being committed to the site respectively a dignified portrayal of the persecuted and victims on the other. This *dual case of advocacy* (Haug 2015: 284) is dealt with by uploading an *aura* at the historical sites (cf. ibid.).

3.2 Children's learning conditions in dealing with the NS past in primary school lessons

Children encounter the NS past not only by chance, e.g. in the media and in family discussions (cf. Koch 2017), but also demand their participation in the remembrance discourse and see themselves as competent discussion partners (cf. Flügel 2009: 296ff.). Hanfland (2008) affirms that 9- to 12-year-old children are able to conduct specific operations of historical meaning in topic-related reconstructions and interpretations and thereby show historical abstraction and argumentation skills (cf. ibd., 200ff.). However, the children's mental (re-)presentations of NS history also have problematic aspects: Besides latent anti-Semitic fragments (cf. Becher 2009: 201), the so-called *Hitler(centr)ism* (cf. ibid.: 196) is a central feature of their historical (re-)constructions. Flügel (2009: 300) sees this as a reflection of German society's remembrance discourse (cf. Flügel 2009, 300).

Despite the lack of a curricular stipulation of the NS topic for the primary school, in the discourse of primary school pedagogy, the question of whether the NS past should be addressed with children has meanwhile been transferred to the question of how this can be done (cf., e.g. Pech 2012). There are a few positive practice reports on dealing with the NS past in primary school teaching (cf. e.g. Rohrbach 2005), but an empirical analysis of topic-related teaching materials shows stereotyping, while a survey of teachers points to their uncertainties (cf. Enzenbach 2011). In this respect, the professional foundation of subject-related teaching practice at primary level has so far been questionable.

4 Research Design

Taking into consideration that, in empirical studies and in didactic or programmatic articles concerning the thematization of NS in primary school lessons, children are marked as a specific group whose particular needs and learning conditions require a special

reflection of the imparting process, it can be assumed that this premise is seized in education work with children at NS memorial sites. Thus, it can be expected that, compared to the education work with adolescents, some kind of adaption or specification of the pedagogic work with children at NS memorial sites takes place.

In order to analyse the specificity of these settings, I accompany various educational activities with children such as guided tours, workshops or a specific pedagogical event called 'Kindersprechstunde', which is some kind of a children's consultation hour. It is conceptualized as a regular pedagogical holiday offer of a specific NS memorial site to which the children from the age of eight to twelve can bring in their own questions in advance and discuss them with the experts on site. The events I accompany include visits by school classes as well as visits by children made in their leisure time, for instance, when they visit the 'Kindersprechstunde'.

These events are observed at different NS memorial sites in an ethnographic manner, partly with the help of a mobile camera. The advantage of video recordings is seen in the fact that it enables detailed documentation and conservation of the complex events during the fieldtrip as well as the application of alienation techniques during the analyzation work afterwards. The complexity of the perceptible in the videos requires further selective procedures for the processing of the material in the sense of a comprehensible presentation of analytical contexts. Oriented on the scenic progressions, the material is segmented in a tabular form including file name, temporal anchor points of the individual scenes, short descriptions as well as a first coding suggestions (cf. Rabenstein & Steinwand 2016: 249) according to the Grounded Theory. Then, with a view to the analytical interest of the research questions, particularly dense scenic action units are selected and transferred into scenic descriptions. In cases where no video recordings can be made in the field, observation protocols based on the field notes and situational memories are written immediately after participating the event.

Scenic descriptions and observation protocols, which are both to be understood as *focused protocols* (cf. Reh et al. 2015: 45), are analysed in a combination of Grounded Theory (Strauss & Corbin 2010) and sequence analytical interpretation (cf. e.g. Deppermann 2008), which occurs under the use of the computer program MAXQDA from a practice theory perspective. Such focus on *situated practices* (cf. Breidenstein et al. 2015: 32) enables me to turn away from questions of didactic implications, moral claims and motives and to turn to *situational circumstances* (cf. Hirschauer 2017: 94) and their practical procedures. This includes the analysis of linguistical and physical references to things such as subjects, (im)material or spatial objects as the site itself.

According to Hillebrand (2014: 29), practice is defined *as reality in execution that only manifests itself when it literally happens.* My aim is *to grasp the 'performance' of practices* (cf. ibd.) which catenate with one another and form practice of education work with children at NS memorial sites. With such a practice theory approach, I attempt to explicate the implicit, symbolic orders, cultural codes and horizons of meaning (cf. Reckwitz 2008: 17).

5 Potential Contributions to the discourse of out-of-school Learning in primary school pedagogy

Scholz and Rauterberg (2008: 51) claim that *school considers the world in a certain way and thus creates its own reality*. To pupils in their classrooms, aspects of the real world therefore regularly appear as simulation respectively in a didactically reduced way (cf. Baar & Schönknecht 2018: 11). From this, in the pedagogical work with children in primary schools, the demand is arrived to enable children to *deal with the concrete lifeworld* (cf. Hellberg-Rode 2009: 145). This demand is based on the assumption that by interrupting the daily routine of school outside school, new horizons and new spaces of experience can be revealed (cf. Budde & Hummrich 2016: 37) – experience that cannot be imparted in school itself (cf. Thomas 2009, 284). Consequently, out-of-school

places of learning are regularly visited, which is in particular in 'Sachunterricht' regarded as an indispensable didactic concept in order to ensure a basic general education (cf. Sauerborn & Brühne 2010, 13). Generally, any place can become an out-of-school place of learning as long as its visit is integrated into the school's educational mission and oriented towards the requirements of curricula and guidelines (cf. Baar & Schönknecht 2018, 15ff.). It is supposed that such places show a reference to reality owing to an illustrative visibility, an opportunity of encountering the original or the chance of making primary experience, which describes a personal intensive experience won in a direct contact to reality (cf. Karpa et al 2015). Such an experience is believed to activate the students cognitively, to be the basis of connectable knowledge and support the development of values and attitudes (cf. ibd.).

Yet, this programmatically assumed potential as well as the effectiveness of out-of-school learning in general has hardly been empirically explored, so far (cf. Baar & Schönknecht 2018). Also, an analytical and systematic examination of the relationship between (primary) school and out-of-school learning locations is still pending. This also applies to the thematization of the NS past with children, where the *relationship between the thematization at school and offers from memorials and museums* (cf. Pech 2012, 21) is still unresolved.

The ongoing research project which has been briefly described previously mainly aims to provide an explorative description of pedagogical work with children of primary school age at NS memorial sites and to offer a detailed analysis of meanings as well as symbolic and cultural orders that take local effect. The research results can then be reflected with reference to didactic discourses on out-of-school learning in primary school pedagogy, particularly considering discourses on historical-political learning in 'Sachunterricht'. This enables a revelation of the didactic potentials and the didactic challenges of such specific learning places in the context of children's dealing with the NS. Merging such aspects with

discourses of memorial sites pedagogy additionally allows to give an exemplary but however empirically based contribution to the determination of the relationship between out-of-school learning places and school.

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Dr. Markus Schaal

Martha Muchow in the Context of the New Sociology of Childhood

What Can a Classic Still Teach Us Today?

The rediscovery of Martha Muchow's 'The Life Space of the Urban Child' (1935) by Jürgen Zinnecker in 1978 sparked academic debate about children's appropriation of urban space in Germany. Through the naturalness of Muchow's description of the independent mobility of children, she directed attention to the changes that have occurred since then for the city child. In this way, the book became very influential and belongs to one of the most cited works at the intersection between sociology, social work/ pedagogy and human geography. But as so often happens with classics, the book is often mentioned today, but usually only with a reference to the fact that the children explore the city in zones. Thus, according to my central thesis, the current significance that the work could have for us is not fully realised. In this article, I would like to take a second look at Muchow, paying specific attention to her research methods, her perspective and, highly selective, her insights. In order to do so, I would like to briefly introduce the central aspects of her major aforecited work. In addition, I will examine the relatedness of this study to the three main strands of modern childhood studies. The concluding chapter will reflect on the legacy of this classic work, and speculate on its possible significance for contemporary research.

1. Introduction

The decline in the independent mobility of children in recent decades is well documented in the literature of human geography, sociology, education and sports science.[19] Empirical indicators for

19 The literature on this subject is now so varied and extensive that I cannot list it in detail here. However, one of the largest international (quantitative) research projects on this topic was conducted by the Policy Studies Institute in London. It includes a longitudinal

this trend in the relevant literature are above all school travel and the so-called ‘mobility licences’ granted by parents to their children. Longitudinal studies show that in western industrialised countries, fewer and fewer children travel to school independently and that parents are increasingly restrictive regarding their children's scope for independent action. When parents are asked why they no longer allow their children to go outside alone, road traffic and so-called 'stranger danger' are mentioned as possible threats to their children.[20]

The debate on independent mobility of children is thus mainly a debate of loss and deterioration, especially in Germany. Today's image of a domesticated and institutionalised childhood is implicitly contrasted with an ideal image of street childhood. In this ideal picture of street childhood, children do not spend the whole day at school or in other educational institutions; instead, they spend a great deal of time outdoors, among their peers. They take the chance to explore and appropriate their immediate environment independently and without permanent supervision and/ or instruction. The subtext of this view is that they move around freely, acquiring enough exercise and social skills in their peer group, simultaneously learning practical skills by dealing intensively with their immediate environment. One could say that they socialise

perspective and also concludes that the independent mobility of children is declining (Shaw, Ben and others, 2015). A good and more up-to-date overview of international research is provided, for example, by Joachim Scheiner (Scheiner, 2019). A more methodologically oriented overview is provided by Bree Bates and Michelle R. Stone (Bates and Stone, 2015).

[20] Other factors that influence the degree of independent mobility of children are the age and gender of the child, the built environment, the proximity of desired destinations, the social environment, as well as the socio-economic status and car ownership of the family of origin. For recent research please see (among others): Buliung and others, 2017 (for Canada); Carver and others, 2014 (for the UK); Cordovil and others, 2015 (for Portugal); Curtis and others, 2015 (for Australia); Easton and Ferrari, 2015 (for the UK); Kyttä and others, 2015 (for Finland). For an up to date overview on the independent mobility of children, please see Larouche, 2018, p. 53-76.

themselves, so to speak, by independently exploring their environment and themselves within it (Zinnecker, 2000).

The debate in Germany was led and initiated primarily by educational and social scientists. Jürgen Zinnecker played a decisive role in this. He rediscovered and then re-edited the book "The Life Space of the Urban Child" in 1978, originally published by Muchow in 1935. Due to his positive comments on the book and due to his publications inspired by the book, the topic became extremely popular in Germany and initiated many further publications in the latter decades of the 20th century (Deinet, 1999; Zeiher, 1983; Zeiher and Zeiher, 1994; Zinnecker, 1990)[21]. Consequently, Muchow's book became an inescapable classic, quoted extensively by authors who have dealt with the spatial mobility of children in the city. In Germany, it has become one of the most cited works, not only in the field of research on the independent mobility of children, but also in the field of children's appropriation of space in general [22]. In the Anglo-American world, the study went unacknowledged. It was only its 2015 translation and inclusion as part of a comprehensive anthology that attracted some attention (Mey and Günther, 2015).

Yet the question remains regarding the relevance today of a work published almost 90 years ago. First, it is worth revisiting a time when street childhood was more or less taken for granted, not only because one encounters the implicit ideal image of many contemporary authors as described, but also because we can see a different view of children, one that assumes enough robustness to

[21] As representatives of many others, I only mention the most prominent publications dealing with the topic of independent mobility of children. I have determined the degree of prominence through Google Scholar. Moreover, I have chosen only those representatives of the debate who have also made a theoretical contribution to the overall debate. The various empirical studies on this topic are so numerous that I cannot list them all.

[22] According to Google Scholar, the study is cited 421 times, quite a high figure for a German study.

thrive in quite unfavourable environs. Perhaps the natural acceptance of the presence of children in public space can give us some ideas for improving the current situation. A second aim of this paper is to highlight the contribution that Muchow has made to the 'new sociological childhood research'. Like many classics today, she is only honoured and cited for very few aspects of her research but, in line with the argument here, can provide more impulses for our contemporary understanding of children's independent mobility.[23] Finally, I do not want to ignore the critical aspects of the classic study presented.

In order to better understand Muchow's study, the introductory chapter will focus on her underlying perspective. In addition, I will briefly talk about her rediscovery by Zinnecker, and Muchow's life story. Chapter 2 reconstructs how Muchow imagines the process of appropriation of urban space by children, and what distinctive features are highlighted in her work. The focus will not be on content so much, but more on her methodological approach, because the empirical approach is closely related to Muchow's specific understanding of the child's life world. At the end of Chapter 2, I will critically discuss Muchow's approach. Finally, I will consider her significance for research and pedagogy today.

2. Martha Muchow: Rediscovery, Personal Background and Research Perspective

The study on the life space of the urban child first appeared in 1935 in a series of publications that were only accessible to subscribers and was almost completely forgotten in post-war Germany. Jürgen Zinnecker first came across Muchow's study at the end of the 1970s and his resultant enthusiasm led to its republication in 1978. In this new edition, he describes his discovery of the study, as well as the ignorance of the Psychological Institute in

[23] A typical mention in this reduced sense takes place at (Kogler, 2015).

Hamburg of the time towards its own history. He also stated that the study, with its description of the urban street life of children in a working-class district in Hamburg in the 1930s, had greatly inspired his own subsequent research work. The success of this re-release stands for the fact that the enthusiasm cannot have been his alone. In the new edition of the study from 1998, Zinnecker recorded that 'The Life Space of the Urban Child' in the 80s “became one of the most frequently quoted studies of contemporary German social scientific research into childhood” (Behnken and Zinnecker, 2015, p. 8).

2.1 Martha Muchow: Background

Muchow (1892-1933) grew up in Hamburg and worked there as a teacher in an elementary school from 1915. Just one year later, she volunteered for the Psychological Laboratory. This marked the beginning of her 17-year collaboration with William Stern, who then headed the Psychological Laboratory and later the Psychological Institute of the University of Hamburg. At about the same time (1919), she began her postgraduate studies, and in 1923, she was the first woman to receive her doctorate at the newly founded Psychological Institute of the University of Hamburg.

Stern (1871-1938) supported Muchow. He managed to obtain her leave of absence from school teaching, and employed her first as a scientific assistant and later as an academic councillor. In 1933, both of their careers were quickly and permanently terminated after the National Socialist takeover. Like many other employees, they had to leave the institute during its "Gleichschaltung" (enforced conformity). This event coincided with her mother’s death, and culminated in Muchow’s suicide shortly after her final dismissal from the Institute in 1933. Her work on the study of the life world of the city child was unfinished at that time. Muchow's brother compiled and supplemented the existing materials, and they were published posthumously in 1935.

2.2 The Perspective of ‘Critical Personalism’

I would like to highlight here just one aspect of her diverse interests, which I believe is central to understanding the study about children's life space. For it is above all her very specific way of interpreting and empirically implementing the "critical personalism" of Stern[24], that became a characteristic element of the study. Stern is considered one of the founding fathers of differential psychology and researched the personality trait intelligence in particular. However, he always took it for granted that personality traits can only partially describe a person. Similarly, experiments cannot capture the personality of a human being, since they can only investigate reactive behaviour to a given environment.

A person, on the other hand, according to Stern, can make a difference by acting on his or her own. The person can act from within and has the power to bring about his own development and self-completion. So it is neither nature nor nurture (nor both together) that determines a person and their development. It is rather the ambitious self-motivated activities which form a unified whole, namely the person, from the given dispositions and environmental conditions. Both Stern and Muchow explicitly apply this to children who, in this conception, participate actively in their development and in the unfolding of their personality.[25] As we will

[24] The following very simplified description of "critical personalism" follows the account of Rebecca Heinemann, who in particular worked out its significance for the child and youth research by William Stern (Heinemann, 2016, Chapter 5). James T. Lamiell (2006) especially emphasised the warnings of Stern to exclusively rely on quantitative methods, experiments and statistical analysis, and especially his effort to avoid this one-sided conception of man and instead establish a non-materialistic but still scientifically defensible conception of the human person.

[25] This idea of a child actively participating in its development is obviously very similar to the idea of a “productive processing reality” subject, which only emerged much later in Germany (Hurrelmann, 1983). It is all the more astonishing that this very apparent connecting line has obviously not yet been systematically and thoroughly worked through. There are only isolated references to this historical precursor of the model of productive

see in Chapter 2.3, this view mainly influences Muchow's third spatial dimension: the ‘space that the child lives’, but ultimately has consequences for all spatial dimensions in the life-world study.

3 The Life Space of the Urban Child Revisited

3.1 The Three Dimensions of the Child’s Habitat

If we apply this perspective to the child's relationship to its habitat, it means that a certain environment does not exist for itself but is actualised by the active contribution of a person (or a group of persons) acting purposefully within it. This means that Muchow must consistently conceptualise all spatial dimensions from the child’s perspective, because we must be able to identify their specific contribution to it. Later, we will discuss how far she succeeds in this.

Let us now turn to the three spatial dimensions that Muchow described in her study. The geographic space in which the child moves is only the starting point for her efforts. She describes this first dimension of the child's habitat as the ‘the space in which the urban child lives’ (Muchow and Muchow, 2015, p. 66). This refers to the geographical extent of the territory they actively explore and play in. To figure this out, Muchow asked the children to indicate the territory in which they usually move on a map. She asked them to differentiate between the so-called ‘play space’ and a larger ‘roaming space’. The former refers to the places that are played in daily, and the latter to the more distant places that are visited only occasionally[26].

processing reality. In my opinion, Zinnecker has pointed out this linkage most clearly so far (Zinnecker, 2000, p. 280 see also Hungerland, 2015, p. 255).

[26] To mark the ‘play space’, children were instructed to: “…colour all streets and public places blue that you know very well, where you play often, that you pass often, and that you can visualise when you close your eyes”. The ‘roaming space’ was presented to the

The second dimension in Muchow's study is 'the space that the child experiences'. For this dimension, Muchow used two empirical methods: She first interviewed the children and then had them write essays about how they spent their weekend. The aim of the survey was to find out about their favourite places and games. The main purpose of the essays was to learn about the children's family life and about any special recreational activities at the weekend (as opposed to the weekdays). This is by far the shortest and least elaborated chapter, and will not be expanded on here.

The most interesting part of the study is the third dimension. Muchow calls this dimension of the urban life space 'the space that the child lives'. For this dimension, she has chosen the method of observation. Based on the previous project steps, seven locations were selected for observation, which were particularly popular with the children. In order to get a detailed picture of these places, a combination of short- and long-term observations (at different times of the day) were used. The aim was not to investigate how the urban environment influences or shapes children's behaviour, but rather how the world presents itself from the children's point of view, or in other words, how they actively adopt their urban environment.

3.2 The Concentric Zone Model

In most cases, Muchow is only praised for her idea of a zonal expansion of the life world of urban youth. In her study, she describes a certain form of the child's appropriation of space, namely, that children appropriate space in concentric circles. Starting from their own home [27] and the immediate neighbourhood, the

children as the space: "…you have passed, but that you don't know as well as those coloured blue" (Muchow and Muchow, 2015, p. 66).

[27] The centre of the child's world of experience is the parental home, which is, however, to be regarded as belonging more to the sphere of the family and is therefore not assigned to the urban lifeworld of the child, according to Muchow: "Therefore, the home is more of a

children expand their range of action with increasing age. Since the child spends a great deal of time on the nearby streets, these are considered to be home territory from which one gradually moves further out. In actual fact, there are two components on which the model of concentric zones is based: on the one hand, the idea of a core zone around the parental home, which the child transforms into its home territory, and on the other hand, the idea of the expansion of the child's life space from there and in layers.

With this description Muchow pursues two goals. On the one hand, she wants to describe how the children actively transform a certain urban area into their home territory, and on the other hand, the different layers and zones serve to describe inter-individual differences between the children. The first aspect is described as follows: “The street is a second or extended home. With warmth and pride, children speak of ‘their’ street as incomparable to any other in the district, or even in the city, despite objectively having no special features that make them better than the other streets. […] Yet it is part of the children who love it and call it ‘home’. This is where they have their ‘friends’. They know every nook and cranny, and are familiar with the entire neighbourhood. It is from here that they orient themselves as to the district, the city, and to life.” Muchow also leaves no doubt that this sense of home is created by the children themselves: “For this reason, home as a creation of the self only comes to life and is present though active experience” (Muchow and Muchow, 2015, p.84/85). As an example of this active creation, she describes the fact that the children

‘family space’ than an urban space” (Muchow and Muchow, 2015, p. 142). However, this applies mainly on weekends, as Muchow restrictively remarks. During the week, the child's own street is his or her home (see quote in the main text).

defend 'their street' against other (invading) children, and thus establish or strengthen social cohesion among themselves[28].

The second aspect that Muchow clarifies through the zonal description of the children's life-world is the different use of space by the children: “As we can see, it is not possible to assert even an approximate equivalency of the ‘experienced’ life space. While some children are restricted to their own ‘four walls’ or immediately surrounding streets, others have walked stretches of their native city that, when added together, would reach all the way to the gates of BERLIN” (Muchow and Muchow, 2015, p. 69). Consequently, she puts some effort into highlighting the differences in the use of space between children. For example, she describes that the ‘roaming space’ of the boys is larger than that of the girls, a finding that was later confirmed again and again. She also investigates whether differences in intelligence, age or the level of assistance required by the family affect the children's use of space.

So her emphasis on the gradual expansion of the child's life world is not so much about the zones as such, or about the layered expansion of the child's life world, as is often falsely claimed.[29] It rather serves to make two things clear to us: First, Muchow shows us how the children actively transform a core zone into their home. Furthermore, the zones serve her to describe inter-individual or social differences and their interaction with the children's encounter with their urban environment. In so doing, she not only

[28] Muchow describes this 'defending our own street' as follows: “This is most vivid and present in the struggle for home. Home is what is defended, and the ‘enemies’ that attack it are ‘strangers’” (Muchow and Muchow, 2015, p. 85).

[29] Her concept of ‘concentric circles’ to understand children’s appropriation of the urban space is definitely not the most important finding of her study and she most probably just adopts this idea from Ernest Burgess, who created it together with Robert E. Park to describe the structure of the North American city. I cannot prove this thesis, but Muchow was definitely familiar with the literature on urban sociology in the USA,especially since she undertook a four-month research and lecture trip to the USA in the winter of 1930 during which she also made a stopover in Chicago (Faulstich-Wieland und Faulstich, 2012, p.30).

highlights children's active engagement with their environment, but also opposes the assumption of a uniform basic structure of child development, with the sequence of developmental stages and the passage through phases that build on each other, such as that described by Jean Piaget.

3.3 The Space That the Child Lives

To make this special perspective clear to her reader, Muchow contrasts the children's viewpoint with the adults' viewpoint in the presentation of her results. She usually begins with a formal description of the actual conditions on site, then describes the more rational use of the place by adults and contrasts this with the child's perspective. With this kind of description, she is able to clarify that there is no space independent of the subject (and their perspective) and that the appropriation of urban spaces by the children is an active practice[30]. It also becomes clear that the child-like practice of appropriating space takes place through the medium of play.

I would like to take a closer look at the example of 'Karstadt Department Store', as it contains a particularly elaborate description of appropriation, although the place is actually not accessible to children at all. As already mentioned, Muchow starts with a neutral description of the department store as a "centre for satisfying the practical needs of adults" (Muchow and Muchow, 2015, p. 131). But even for adults, it is more than that; it also has the character of a museum in which the modern consumer goods are exhibited. It is a kind of 'sight', a place of (mainly female) sociability. You enjoy the variety of goods and follow the various wishes of your fantasy, as Muchow aptly describes the adults' behaviour.

[30] Particularly outstanding in this respect are the descriptions of the 'loading dock at the Osterbeck Channel' (a place for unloading cargo from ships on a canal) and the 'Karstadt Department Store' (Muchow and Muchow, 2015, p.92-106 and p.131-140).

The approach and perception of the children is completely different. For them, the department store is an adventure playground with the charm of the forbidden. The biggest adventure is first to gain access to the department store past the gatekeeper, which is extensively described by Muchow and for which the children have to show cleverness, cunning and imagination. Muchow provides a fascinating description of the different methods the children use to gain access to the department store, which, unfortunately, I cannot elaborate on here due to space restriction. Once the children have gained access to the department store, there are various interesting activities to pass the time there, depending on age. The second adventure is, so to speak, the 'playing' stay in the department store, avoiding detection and ejection.

3.4 Summary and Critical Appraisal of Martha Muchow

Muchow's study works on three different levels of analysis. First, there is the physical environment or geographical space. At this level, Muchow quantifies, for example, the children's play space or roaming space on the basis of information provided by the children themselves. The neutral descriptions of the children's play locations that Muchow provides in her third dimension (the space that the child lives) also belongs to this level. On a second level, Muchow examines the inter-individual differences of children or the social context in which they live in relation to this geographical space. She wonders, for example, whether the size of the roaming space depends on the child's intelligence, gender, or the degree of help in the home expected of the child. In doing so, the two quantifiable levels of the study are interrelated.

The third level of the investigation is not quantifiable. Here it is a matter of understanding the child's appropriation of the world. The aim is to understand how the child transforms the environment into its own personal world. Muchow describes it as follows: "Only when we see how children deal with particular and substantially characterised pieces of the adult environment, and how this

results in totally different observational structure of how they relive a certain urban section into their world, do we recognise the true 'life space of the urban child'" (Muchow and Muchow, 2015, p. 143). One could also call this level the phenomenological level of her investigation, constituted by the child's own intentionality[31].

But there is also a problem with this third level. The more Muchow emphasises that children live in their own personal world and transform the environment into their world, the more problematic the method of observation becomes. This is because we cannot be sure if the interpretation of the adult observer is correct. Today, one would definitely try to empirically include the child's perspective in this dimension as well, but Muchow did not take that step.

Nevertheless, it remains a great achievement of Muchow that she distinguishes and relates the three spatial levels to each other. This is driven by the concern to understand the world of children, as well and as comprehensively as possible. She thus not only advocates an approach that is oriented towards the perspective of the child, but also always considers the concrete temporal, local and social context of the object of investigation. Therefore, Muchow calls her own approach: "…culture-typological youth psychology" (quoted from: Faulstich and Faulstich-Wieland, 2015, p.204).

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[31] Muchow is influenced both by the quantitative approach of the psychology of her time (dominated by experiments and generalizations) and by phenomenology (on which she wrote her doctoral thesis). In her study she tries to combine both perspectives. Her methodological approach reflects this by containing both quantifying and qualitative elements (or elements of understanding). In a sense, she describes a quantitative analytical space as well as a phenomenological space, and both, and this is the decisive point, are related to each other. She is therefore without doubt an early advocate of overcoming methodological dualism. Peter Faulstich and Hannelore Faulstich-Wieland describe this as follows: "Although not explicitly,Muchow distinguishes an analytical space in which factors such as frequency of attendance or catchment areas can be empirically ascertained, and a phenomenological space that is constituted by the children's own intentionality and corporeity. These spaces are then combined into the relational space that is situationally made concrete where learning takes place" (Faulstich and Faulstich-Wieland, 2015, p. 205).

With this point of view, Muchow turns on the one hand against a purely quantitative approach based only on measurable and numerical variables of the child's environment. On the other hand, she also opposes attempts to grasp children and childhood with the help of generic and generalised categories, like those of Jean Piaget. Childhood for Muchow is therefore always concrete, always related to a social position (working-class childhood), a specific social structure (density of the big city), a place (Hamburg) and a specific cultural imprint (North German): "Großstadtkind sein, Arbeiterkind sein, Hamburger Kind sein – diese drei Bedingungen formen zu ihrem Teil an dem werdenden Menschen" (quoted from: Faulstich-Wieland and Faulstich, 2012, p. 94)[32].

The consistent orientation towards the children's world of experience has also saved Muchow from too much pessimism. Contrary to the pessimism towards the big city, which was prevalent in her time, she maintains a value-neutral view, which does not make a certain value judgement about the child in the big city from the outset. In contrast to the great cultural pessimists of her time, she paints a thoroughly optimistic picture of the big city, as it provides the child with a multitude of opportunities for play and activity, even though there are, of course, numerous restrictions and limitations. This is precisely what characterises Muchow, that she has a fundamental confidence in the ability of children to appropriate spaces, even under rather adverse conditions.

The study should thus be remembered for its innovative perspective on urban space, its interconnected empirical implementation, for its interest in the child's perspective, as well as for its freedom of any moral value judgement. But Muchow also makes something

[32] To my knowledge, this passage has not yet been translated, so here is my own attempt at a translation: "Being a child of the big city, a worker's child, a child of Hamburg - all three conditions form part of the future human being". In the complete paragraph, Muchow mentions the North German culture in addition to the factors mentioned here, so I have also included it in my text.

general visible, namely the fact that the child actively appropriates its world and, in a sense, creates a space for itself that overlaps the space of adults:

> "The examples that we pointed out in the third chapter of our study all point in the same direction. They indicate that the life space of urban children is not constructed alongside that of urban adults (since much of the adult world content is also lived by the children!), but are superimposed, or better, interspersed" (Muchow and Muchow, 2015, p. 144).

4 Martha Muchow in the light of Modern Childhood Research

In the last chapter, I have tried to highlight the special achievements that have made Muchow a classic author. It has become clear that she is concerned with the independent mobility of children, but at the same time, her research interest goes beyond that. Ultimately, she is concerned not only with the independent mobility of children, but above all with their ability to appropriate urban space in their own way. In my presentation of her argument, I have largely confined myself to her major work on this subject, which is still most often quoted today. In so doing, I have not only tried to work out her respective main line of argument, but have also addressed her specific theoretical or conceptual perspectives and points of criticism. In these last two chapters, I would like to look again at the impetus that Muchow gave to the subsequent research and what possible significance her research could have for our situation today.

Today, Muchow is often quoted exclusively for her model of the zone-like expansion of children's lifeworld. The ever-more expanding geographical zones are then contrasted with the ‘islands’, which are thought to shape the way children perceive space today (Zeiher, 1983). According to this thesis, children lose touch with their environment, since they no longer travel independently. Their range of action may have expanded, but they no longer

notice the route from A to B since they use public transport, or they get taken somewhere by car. The distance between the places visited is thus only perceived as time passed and the children's destinations become ‘islands’ in a space no longer perceived. It is obvious that the world of children described by Muchow is the ideal counter-image to this fragmentation of the child's spatial experience. It not only stands for a gradual expansion of the child’s life world, but it also implies an intensive engagement with the environment and a holistic spatial experience.

In most of Muchow's contemporary references, her model of the zone-like expansion of children's play space thus serves as a background against which the fragmentation of children's living environments can be described and understood. This obvious interpretation sometimes makes one forget that she has given another important impulse to childhood research. In order to explain and classify this better her perspective will now be placed within the three main directions of ‘modern’ or ‘new’ childhood research. According to Doris Bühler-Niederberger (Bühler-Niederberger, 2010, p. 438-440), three major approaches to the new childhood sociology can be identified. The first is looking at childhood as a structural form and its most important representative is Jens Qvortrup. This perspective can be understood as a form of social structure analysis and looks, for example, at the intergenerational distribution of resources in the welfare state (Qvortrup, 1998 and 2009). Within the second approach, childhood is to be understood as a social construction, and thus has to be seen as culturally and historically variable. By defining and ordering several age groups and by assigning specific rights, obligations and resources to them, we demarcate the boundaries between different *generations,* or in other words, we are *doing generation* (James and Prout, 1990; Alanen, 2005, p.78/79).

The third approach advocates that children should no longer be regarded merely as passive objects of adaption and socialisation. It is criticised that sociology has for too long dealt with children

almost exclusively in the context of socialisation and education, that is, how children acquire the norms and values of society and how they learn to become good and productive adults. Instead, it is argued that children must be conceptualised as "social actors in their own right" (Alanen, 1988, p. 60). We are thus encouraged to hear the voices of children and to acknowledge their active contribution, not only to their own lives, but also to the societies in which they live (James and Prout, 1990, p. 8).[33]

It is this third approach in whose tradition I see Muchow. She is an early representative of a perspective that emphasises the agency of children and does not only see them as passive recipients of education and socialisation. This is supported, for example, by the fact that she directs her attention primarily to children outside of educational institutions. As a result of this preliminary decision, children are presented to us in a setting in which they act independently. Instead of children acting under the guidance of adults, we see children in situations in which they independently appropriate urban spaces that are not actually intended for them.[34] The interest in what the children do with each other and in their everyday life (independent of adults) points in the same direction. It also emphasises that children are able to create something on their own and that what they do with each other matters (peer culture).

In Muchow's work, the children's 'agency' is revealed above all through their play. Children appropriate the world through play and in the process of this appropriation, they create their own

[33] At the same time, it must obviously be recognised that children are in many ways dependent on adults. When examining their active contribution to society, one must keep this limitation in mind.

[34] I also think that Muchow has a sense that this does not mean that these children act entirely free from the influence of adults or structural conditions, but rather that they make full use of their scope for action.

world. In a way, they are forced to transform the world into their own because "… the child is quite maladapted to this 'adult world'" (Muchow and Muchow, 2015, p. 143). This maladaptation, however, does not lead to withdrawal or deprivation; on the contrary, it challenges the children and encourages them to develop creative (appropriation) ideas, especially if a certain place seems attractive to them. In the example of the Karstadt Department Store, this can even lead to children instrumentalising adults for their own purposes[35].

5 Conclusion

Martha Muchow is thus an early forerunner of a view that emphasises the agency of children. This view has finally established itself as an essential perspective of the new sociological childhood research in the 1990s and 2000s, and is now, according to an article by Allison James in the Palgrave Handbook of Childhood Studies, "one of the most important theoretical developments in the recent history of childhood studies" (James, 2009, p.34). This point of view has contributed to the fact that in sociology today, children are no longer only addressed in terms of their socialisation, namely their successful growing up, but instead are now seen as people who can make a difference through their individual actions.

This brings me back to the starting point of this article. There, I pointed out that the independent mobility of children has decreased significantly in western industrialised countries in recent

[35] For example, by offering themselves to them as an escort, in order to get into the department store at all. In this example, Muchow describes how the children offer themselves to the adults as sons or daughters in order to prove that they are accompanied in order to gain legitimate access to the department store. It is fascinating that Muchow does not allow herself to be tempted to pass moral judgement on the children, but consistently strives to describe the situation from the children's point of view. Her orientation towards phenomenology, as well as the critical personalism of Stern, contribute to this view. The former forces her to remain neutral in her description (epoché), and the latter to consistently adhere to the viewpoint of the person under investigation.

decades. Above all, this means that children no longer spend so much time outdoors, that they are much less likely to make their everyday journeys independently on foot or by bicycle and, as a result, are less often among their peers. I have already shown in this context that this trend is often described and interpreted as a loss. Classics such as Muchow are often mentioned today because for these authors, it was perfectly natural that children went outdoors independently. Muchow serves as an idealised counter-image to the childhood of today, described as domesticated, institutionalised and heavily dependent on adults.

We are thus clearly dealing with a paradox here: In theory, the view has been established that children make an independent contribution to our current social reality. However, if we look at the current social practice, we see that children are becoming increasingly dependent, for example, in terms of their mobility or their engagement with the environment. So while from a theoretical point of view, more or less subtle examples of children's independent contributions to social life are increasingly sought and described, there are, on the other hand, clear and strong indications from the empirical research of children's everyday life that an independent exploration of their surroundings is becoming increasingly rare. If at all, this confrontation with the environment takes place in institutional settings and under the guidance of educators, but no longer on their own initiative.

As we know from various studies, the lower independent mobility of children is mainly related to the increased concerns of parents. They grant their children significantly fewer mobility licences because they are afraid of traffic and the so-called ‘stranger danger’. Another development that limits the independent activities of children is undoubtedly their increasing institutionalisation. All-day school or the increasing afternoon care of school children are the decisive keywords here. Precisely in this respect, according to my final thesis, the insights of Muchow can still inform us today.

We can learn from her, not to look primarily at a more or less beneficial (built) environment, such as car traffic or the shape of the neighbourhood in which they live. These things are still the main focus of both parents and studies on modern childhood. Instead, we are encouraged by Muchow to focus on the capability of children to take responsibility for themselves, and to observe that they can act competently with regard to their environment. In addition, we should also have confidence in children's ability to appropriate, especially in places that are not actually intended for them. They should thus be given the chance to acquire places in their environment independently and not only to be kept in environments specially created for them. This does not mean that we should ignore the concerns of parents and the real dangers of road traffic. But in view of the declining number of accidents involving children on the roads in recent decades, we should consider whether children could be encouraged to be more independent in their mobility.

And if it is indeed the case that children have to spend much more time in dedicated places because of the increasing workload of both parents, then we should ensure that children can be exclusively (free of adult supervision) among their peers and have independent experiences with their environment.

This encouragement may also include questions in order to find out why children today do not like to spend so much time outside. Muchow's research suggests that we take the step that she herself has not yet taken, but which can actually be derived from her child-centred perspective, namely to involve the children directly in the research process. What do the children themselves have to say about the fact that they are apparently less willing to be outside on their own? Is it because of the adult role models, the lack of outdoor experience at school, or the attraction of the electronic equipment in modern children's rooms? Do they even see this lack of outdoor experience as a loss? There is still far too little

knowledge about this directly from the voices or experiences of children.

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Martin Gröger

Open air laboratory FLEX – Starting to learn chemistry in a near-natural learning environment

The working group didactics of chemistry at the University of Siegen set up an "open air laboratory with experimental field" (FLEX), a place to learn about Nature close to Nature (Gröger 2010 & 2011). Events are offered to classes of all kinds of schools, but with a main focus on primary schools and the subject "Sachunterricht" / general science (natural sciences and social studies). The immediate closeness to the environment and nature provides an extra advantage, e.g. with everyday life and nature-based topics such as obtaining natural colors from plants and dying fabrics.

This article will highlight the advantages provided by a near-natural learning environment like FLEX. It shall show how chemical aspects such as the observation of substances and substance transformation can be a starting point for a phenomenon-oriented view of scientific aspects in nature.

1. Introduction

Experimenting in the very artificial surrounding of a chemistry lab is experienced as rather unrelated to nature and artificial. Nowadays there is a distance between teaching natural sciences (esp. chemistry) and the actual object "nature". Martin Wagenschein, a famous German didactics expert, characterized this distance in an interview concerning his lifework (1981) very nicely:

"Of course, our natural science that can be found and is shown in schools isn't at home in those schools as it hasn't got any nature. It cannot become a natural science because it takes place in concrete blocks, in laboratories with instruction devices and books with sentences in bold print. Thus, it is a science in which nature is not noticeable. I mean 'nature' in the sense of how kids or "simple" people understand the word.

Shouldn't a first reflection of nature, if not in nature itself, at least take place on its edges?

Isn't there supposed to be an initiating consideration of nature, if not in nature, so on its edges? Only so much: glades with trees, rocks, hills, water (standing and running), a shed with all kinds of 'stuff' (material) also tools in it, finally a room in which that what is performed and tried outside, is previously planned, discussed afterwards, written down and learned. A vision, I know" (Wagenschein 1981, p. 169-170).

2. Wagenschein's vision becomes reality

The FLEX complies with those quoted guidelines in many parts so that Wagenschein's vision could become reality. In the process we focus on chemistry as a so far neglected science, concerning general studies, with a special focus on substances and substance transformation as a starting point. Students should experience processes of chemical change in a more appropriate way, closer to the environment and nature as well as connected with other natural sciences. In addition, these processes are combined with other areas of general studies beyond the nature related perspective.

The FLEX (figure 1) is located outside a small village close to a forest. A shed is built on an approximately 6700 m² large meadow with two springs, a small stream and a pond. The shed was remodelled into a small room for experiments ("laboratory") and equipped with extensive experimental material from simplest shovels for the exploration of the ground in the elementary sector up to a mobile photometer for chemical analysis of the environment for the sixth form. By and by wicker tepees, Benje hedges, a phenological hedge, an herb bed, a small field and a "green seminar room" were added among other things. Energy supply takes place self-sufficiently trough solar modules, fuel cells and a wind wheel.

Figure 1: Open air laboratory with experimental field

3. From the phenomenon to the "touchable context"

In Wagenschein's opinion, natural history and science lessons have to start with immediate and tangible phenomena of nature of the children's everyday life. He talks about "natural monuments that immediately appear sensuous; in ways that we sense them as a counterpart and in ways that they affect us without prejudice and intervention, thereby also being unbiased by us and not yet settled on a certain aspect" (Wagenschein 1977, 129).

This approach was more recently highlighted once more. In his article "The discovery of the phenomenal" Klinger emphasized which role phenomena in general studies could play for the initiation of scientific thinking. He concludes: "If things should be clarified and understood, school has to allow the experiencing of phenomena and based on this, has to devise a thinking of science." (Klinger 2008, p. 8) Furthermore, Klinger underlines that phenomena which are noticed consciously by children, e.g. rusting of iron, originate in their everyday life but also affect sciences in their

entire breadth. Against this background he concludes: “Phenomena don’t look after subjects and disciplines. That makes up a part of their fascination and on the other side shows the necessity of an interdisciplinary approach.” (Klinger 2008, p. 8).

This is also valid for the handling of phenomena in FLEX: Phenomena that are easily understandable for kids become starting point and focus of attention. Based on them, explanations that are both appropriate to the children’s imagination and wording/vocabulary, have to be developed. In this process, affective and aesthetic aspects of perception and observation of phenomena are legitimate accesses. Phenomena are not supposed to be interpreted exclusively as objects of scientific interest but they are ideal objects of/for childlike curiosity. They should be explored with all senses. This exploration is a process in which the children’s attention is fully integrated; they are completely “with the matter” and experience the phenomena. For the topic “fire” this means that the children collect wood for a campfire and that they try to light it in different ways, even with flint and scale. It also means that they look at the blazing flames and make use of the fire, e.g. by heating water for tea. Later on, they learn to ignite a little stick and finally, they extinguish the fire.

In this context Buck and Kranich - in the preface of their book “Looking for an experienced connection…” - write about “a genuine, rooted understanding in the sense of Wagenschein. So, to say an experiential saturated realization and comprehension that is carried out by oneself.” (Buck and Kranich 1995, p. 7) Such “experienced connections” are overlooked easily in the bustle of everyday life and as a consequence of our technically designed environment. They “got lost”, in the truest sense of the word, through massive intervention of humans on the natural environment. But if you try to look out for “strange” phenomena from a childlike view, you will find a lot of astonishing things in nature-oriented environments. The apparently banal question “Why doesn’t the water in the pond close to the FLEX leak?” leads, for example, to

the topic “clay”. Further questions can be developed, such as: “Why do you detect clay on certain places in the ground and not elsewhere? How is it formed? Why is clay well deformable and why is burned clay different, simply not deformable and red?” This subject area represents easy comprehensible natural phenomena as an example for an “experienced connection” out of the children’s everyday life and nature.

4. Learning outdoors

In the above-mentioned quote Wagenschein postulates to leave the classroom and to carry out the starting observation of nature for general studies at least at “the edge of nature”. With this in mind, chemical transformation processes on primary school level in FLEX should not be conducted as isolated experiments in a laboratory, but as conversion phenomena in the environment and at the edge of nature.

Visits of extracurricular learning environments should therefore be arranged more often. Henning Schüler, who highlighted the meaning of learning outdoors several times, argues as follows: “But general studies have to open – not all along but with increasing frequency – doors and windows since they deal with life itself. They need a yearning for the outdoors, curious view, they need outlook and occupation, experience and know-how, weather and seasons; only in that way they find to their things and to appropriate teaching and learning.” (Schüler 1999, p. 137) According to Sauerborn and Brühne an extracurricular learning location enables, in particular, original meetings and direct confrontation of the children with learning materials, active participation as well as “the possibility of an autonomous perception of multi-perspective educational contents” (Sauerborn & Brühne 2009, p. 22). Braund and Rice emphasize that visits of extracurricular locations offer a welcomed change from everyday school from the children’s point of view. In a questionnaire survey they assessed that out of 11 possibilities to learn pupils stated the item “going on a science trip or

excursion" as the most pleasant one (Braund & Reiss 2004, p. 11). The authors think that learning outside school is a key component and postulate it to become a component of the curriculum of every school.

From all extracurricular places to learn those are of special interest that are close to nature like meadows and forests, including the learning location FLEX. Learning close to nature is getting even more important regarding the changed childhood in Germany. Nowadays children have considerably less immediate sensual-physical experiences with and within nature because of technical, economic and social changes. An intense preoccupation with natural phenomena hardly happens. This lack of nature experiences leads to a growing alienation from nature. Giest and Wittkowske prove this in several studies. They state: "The distance between nature and children […] seems to grow. Their confessions towards nature are getting more abstract, their ability to realize ecological connections seems to decrease" (Giest and Wittkowske 2008, p. 10).

Therefore, students in FLEX should also develop a stronger awareness of ecological problems: "The learning confrontation with nature and therefore with scientific learning cannot take place detached from the question of human's acquaintance with nature. This basic concept is valid for general studies but also for scientific teaching." (Giest und Wittkowske 2008, p. 10) This reference to ecological questions results in a type of inner needs concerning FLEX as well as other nature-orientated locations to learn (Spitzer, Krischer, Gröger, 2014).

Following the concept of "Living in nature" by Janssen (1988) and Trommer (1988) we basically track the central theme of an original meeting with nature. This includes sensual perception and emotionality, the condition of an inner mood, a learning environment that allows a broad space for fantasy and creativity as given in FLEX.

Environmental education in general studies does namely “not adapt to teaching units according to the printed sheet. It has to find its own didactic ways.” (Schüler 1999, p. 130)

5. Experiencing conversion phenomena outdoors

At first sight it does not seem really obvious to associate nature-orientated learning and chemistry. Indeed, there are hardly any basic approaches by which learning of chemistry is pursued outside a laboratory. Nevertheless, it is not the aim of general studies to impart expert knowledge of chemistry. The perspective frame of the society of didactics for general studies (GDSU - Gesellschaft für Didaktik des Sachunterrichts) points out the following: “ From a pedagogical and didactical point of view, the teaching of general subjects has the challenging task of supporting students in perceiving and understanding phenomena and interrelations from the environment, building up new knowledge independently, methodically and reflectively, developing and preserving an interest in the environment” (GDSU 2013, p. 9). For chemistry this means that children should examine material properties and become acquainted with substance transformation. Plenty of substances and substance transformations can be found in nature. Soil constituents as, for instance, lime and clay, can be considered as natural substances. Additional substances can be found as components, active substances or dyestuffs in plants, e. g. starch, lavender oil and carotenoids. Combustion processes are examples for chemical changes. Nature-orientated conversion phenomena combined with old craft techniques are suitable to convey phenomena and experiences that are almost replaced by efficient large-scale industrial processes these days. Children today are not sufficiently aware of the basic principles of food production (such as cereal and dairy products) and associated connections to agriculture, environment and nature

At FLEX students can sow grains, see it grow, mow, thresh and grind it, bake with the flour and smell, touch and taste the bakery

products. You can take a smell at the odorous plants; leaves and blossoms can be harvested and their scents can be extracted and processed to perfumes and creams. Students can look for tinder fungus and produce tinder themselves. There are further possibilities, e.g. the cultivation of renewable raw materials, which are exemplarily realizable through a soap making process out of vegetable oils such as sunflower oil and plant ashes.

Those topics provide the foundation for all sciences and finally offer all perspectives for the overall treatment of general studies. One examples will be described in detail:

6. Example “clay”

The cluster shown in figure 2 summarizes the topic “clay” structured according to the five main perspectives that are described by the GDSU (2013).

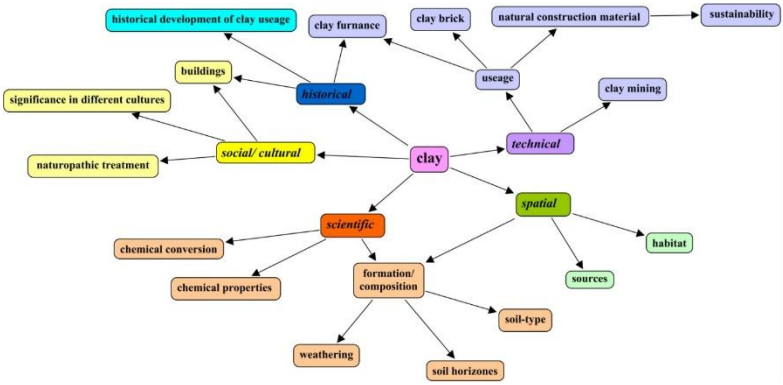

Figure 2: Cluster concerning the topic “clay”

An example for the spatial based perspective is the examination of the formation of clay through weathering. In this context it is also possible to discuss the various types and horizons of soil. Students can look for clay with the help of a soil sampler. Through a finger test and an odour test they can find suitable locations for digging clay.

Now, material properties such as holding capacity, ability of elutriation and plasticity can be examined and experienced with the help of simple experiments. Students recognize that humid clay can be easily processed, and that it becomes solid after drying. Changes between wet and dry and the connected change of material properties can be repeated as often as wanted. Clay can be fired with a simple kiln at the FLEX. During this process, substance transformations become obvious. The fired clay is not mouldable with water anymore and changes its color during the firing. This is an irreversible process. A new substance is generated, resulting in brick or tile. Model houses or a small clay oven can be built with the produced bricks. So you can look at clay from a technical, a social and a cultural perspective. Clay is a natural building material with the features of reusability, insulation, regulation of humidity and the binding of noxious substances. Furthermore, it is sustainable through reusability as well as through low energy consumption when it comes to extraction, transport and processing. Half-timbered houses and clay huts, for instance in Africa, are well known. The historical perspective can be taken in to account with the help of the clay oven (named “Backes”) in the FLEX.

There are a lot of possibilities to link the topic “clay” to previous experiences. Curiosity and the eagerness of explorers can be aroused. The direct and active contact with clay enables students to experience nature with all senses and to get to know the relations between the different perspectives.

In particular, it is possible to contribute to the initiation of chemical concepts by working with clay and including suitable experiments. Students thus can gain insights into the structure of matter. From the point of view of chemical didactics, the relationship between the structure of the substance and its properties can represent a central finding with regard to the plastic deformability of clay: The composition of the clay and the structure of clay minerals as well as the resulting interactions with water are responsible for the malleability.

The fact that such interactions can also be recognized by younger children by dealing with clay is the result of a study carried out with 29 third-graders (Wurm & Gröger 2018).

The children took part in a weekly working group concerned with the subject of clay in the outdoor laboratory. In the analysis of problem-centred interviews and teaching experiments on different characteristics of clay, the malleability proved to be particularly suitable for promoting sustainable and expandable concepts even at primary school age.

Among other things, the children were asked to shape something with different materials and to predict and explain their different plasticity. Here, the everyday experiences of the children were directly taken into account: almost every child at kindergarten age was able to experience that dry sand, unlike moist sand, cannot be formed and which (earthy) components are particularly suitable for building. The analysis of the interview transcripts showed that the children attach great importance to the factor water. However, the composition or the components of the material played only a role regarding the properties of sand and not of clay, which are usually explained with further characteristics (e.g. because it is more stable; because it sticks better). It was also found that after the course in which, among other things, the composition of clay was examined and thematized with the aid of suitable experiments, the children more frequently consider the constituents of the clay as relevant.

Based on these results, a step model was developed which shows how a structural-property concept can be initiated by dealing with the malleability of clay. Both the structure of the clay and the interactions between clay and water are taken into account. In the model, the plasticity of clay is explained on increasingly abstract levels, with technically correct and connectable interpretations to be found at each level (figure 3).

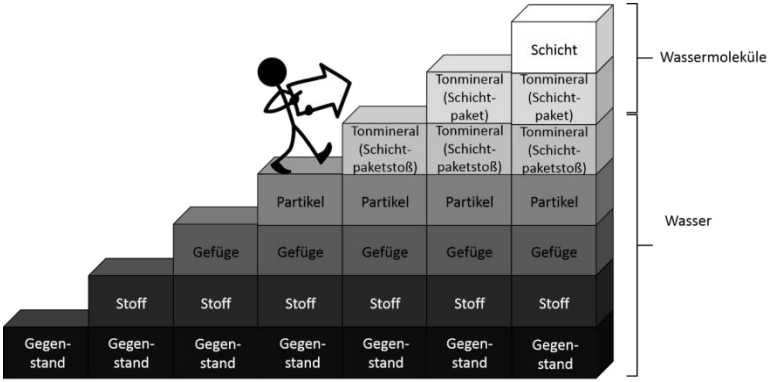

Figure 3: Structure-property relationships to the formability of clay on increasingly abstract levels (Wurm & Gröger 2018, p. 23 and Wurm 2018).

7. Conclusion

Students can experience conversion phenomena and make experiences right in FLEX whereby connections with the environment are not ignored or just mediated verbally. Learning does not take place about the environment but outside within the environment and within nature. In doing so, the perspective alters from mere "mediation" of "natural"-science through the consideration of isolated phenomena in the laboratory and from idealized theory to the experiencing and the recognition of nature in natural science. Authentic learning becomes possible through aspects that are linked to everyday life, nature-related and ecological. Phenomena and relations can be perceived immediately and can be looked at with a multi-perspective view that is based on a chemical approach of the world.

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Martin Gröger is a Professor of Didactics of Chemistry at the University of Siegen. Here he has set up the student laboratories Science Forum, FLEX and Chem-Trucking. His research areas are in

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Martin Gröger

FoodLAB - a molecular gastronomic experimental laboratory in teacher training

During the conference, the FoodLAB of the working group didactics of chemistry at the University of Siegen was inaugurated in a workshop. It is a facility in form of a normal kitchen, in which students of general science do not have to learn about chemical experiments in a chemistry laboratory and experiment with chemicals and hazardous substances, but can get closer to chemistry through lifelike transformation phenomena when cooking/dealing with food and everyday household materials.

1. Introduction

Students of the teaching profession general science for elementary school have to study all perspective areas of general science (GDSU 2013) as part of their studies at the University of Siegen. These include history, social sciences, geography and technology as well as the natural sciences. Here, biology, physics and also chemistry each require a lecture and a practical course.

The lecture for the chemical part is designed as an experimental lecture in order to motivate the students with demonstration experiments as closely related to real life and everyday life as possible, despite the relatively demanding and systematic course.

In the practical course the theoretical basics from the lectures are taken up and deepened by means of experiments. Almost all of these can be carried out within the spatial and experimental conditions at primary schools and with the age-appropriate abilities and skills of primary school children. Apart from getting to know some of the content areas, the students are supposed to reduce their own shyness regarding experiments by working on some simple examples., Additionally, an intensive exchange with the supervisor of the practical training helps them to understand the

experiments and phenomena also in the sense of Wagenschein's "genetic" understanding and, on this basis, to classify the experiments didactically (what, when, how, who, what for). Thereby, the students gain confidence and self-efficacy concerning the teaching of chemically oriented areas in the classroom.

2. Design of the FoodLAB

Most primary school teachers prefer biological topics, because these topics seem to be easier to teach and less abstract. Thus, chemical aspects are underrepresented (Altenburger & Starauschek 2011). One reason could be that chemistry is a very unpopular school subject and a negative attitude towards it often lasts during adulthood (Osborne, Simon & Collins 2003).

The negative experiences during their schooldays and the fact that they are often not aware that chemistry plays an important role in their everyday life obviously influence the course of studies of future primary school teachers. They often try to avoid scientific and especially chemical contents during their studies and therefore do not feel adequately prepared to teach related contents (Tosun 2000).

One way to overcome this problem lies in the approach to connect chemical topics with biological ones (Janssen & Gröger 2017a, b), which we follow in our outdoor laboratory FLEX (Gröger 2010 & 2011). With the food lab we try to bridge the gap between primary school teachers' interests and chemistry by connecting chemistry to food and kitchen, which are also topics that are of importance for students. This is also a way of starting sciences in the spirit of Wagenschein (1977) with immediate and tangible natural phenomena of the children's (students') everyday life.

Until now, we only had a chemical laboratory available for experiments. But experimenting in the very artificial surrounding of a chemistry lab is experienced as rather unrelated to everyday life, factual and even dangerous by the students. Now, new

opportunities arise to deal with material transformation phenomena in a pleasant and familiar environment, thus creating an attractive and multi-sensory introduction to chemistry.

3. Topics

The scientific interpretations are not restricted to the chemical aspect. There are always overlaps with other natural sciences, e.g. with regard to the preparation methods (cooking, simmering, roasting, microwave), especially to physics. Other questions arise about enzymatic processes, taste, digestion and utilization of food components in the body as well as other physiological aspects, which are closely related to biology. This means that an interdisciplinary approach to the initially unbiased observation of the phenomena, as they will later be made by children, is a matter of course in the spirit of Klinger (2008, p. 8).

In general, beyond the natural science perspective, the other areas should also be integrated in a manner that connects different perspectives. For example, within the framework of health education, a part of subject teaching, the subject complex "nutrition" can be directly included by looking at homemade and industrial food products, starting from the scientific aspects of food, its origin and preparation, technical, historical, social and spatial aspects.

The experiments refer to the chemical basics, which are aimed at an understanding of substances, material properties and material transformations.

With regard to nutrition, the aspects of "detection of food components, model experiments on digestion, properties of food, reactions of the ingredients and understanding of food technological processes" can be considered (cf. Klein & Oettinger 1999a, 19-20).

Figure 1: Students cooking in the FoodLAB

Basically, the main components of food, namely carbohydrates, fats, proteins, minerals and vitamins (see Klein & Oettinger 1999a) can be addressed. In more detail, various beverages, enzymes, and fermentation as well as chemicals in food in the form of deliberately added additives or unwanted contamination (cf. Klein & Oettinger 1999b) can also be addressed.

When selecting and planning the topics and experiments, it is always important to ensure that the content is meaningful, that it can be realised with simple experimental methods, can be carried out without special practical training, has a clear effect and that it has a high chance of success (Klein & Oettinger 1999a, 5-6). A nice example is the production and use of red cabbage juice for the detection of acidic and basic solutions.

4. Outlook

The FoodLAB is not only used in teacher education for general science, but also in the training of chemistry teachers for secondary schools. Here, the chemical basics can be discussed more intensively and more specifically. Under the guiding principle "The kitchen - a chemical laboratory" (Schwedt 2010, 1), a large number of books (e.g. Potter 2017, This-Benckhardt 1999, Vilgis 2015) and specialist journals now offer suggestions for experiments on the chemical and physical principles of cooking. More detailed information can be found in standard reference books on food chemistry (e.g. Schwedt 1999).

In addition, FoodLAB is to become part of the Science Forum (Gröger, Scharf & Woyke 2003, 2006) and serve as a student laboratory. In this context, the offers are not university courses, but are aimed at interested schoolchildren from the region, who will then have the opportunity to deal in greater depth with chemical issues from their immediate environment.

With the approach of "molecular gastronomy" (Vilgis 2005, p.8), in addition to imparting basic chemical knowledge as well as chemical ways of thinking and working, a long-term contribution to an increased interest in chemical issues and a more positive view of chemistry should be gained. Chemistry should no longer be seen primarily as an unnatural or even dangerous science, but it should be made more aware that chemical knowledge, products and processes are indispensable components of our daily life (cf. Roth 2010, VII).

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Martin Gröger is a Professor of Didactics of Chemistry at the University of Siegen. Here he has set up the student laboratories Science Forum, FLEX and Chem-Trucking. His research areas are in particular "Extracurricular Learning in the Student Laboratory" and the subject area "Chemistry and Nature".

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Martin Gröger

How Alexander von Humboldt saw the world from a chemist's point of view

14.9.2019 was the 250th anniversary of Alexander von Humboldt's birthday. On this occasion his contributions to chemistry were reviewed. An understanding of Humboldt's chemical research work allows historical and theoretical reflections on Nature of Science, opens up opportunities for independent creative experimentation by learners and provides current references to the discussion on climate change.

1 Reflections on Nature of Science

A large number of Humboldt's writings are easily accessible on the Internet. Learners can view them and follow Humboldt's thought processes in his chemical discoveries. Learners can be supported in evaluating the historical material with suggestions for explicit reflection, such as "How did Humboldt record his data? What new instruments did he develop? What led/pushed him in his research?" (Höttecke & Henke, 2010). In this way, aspects of the nature of the natural sciences can be considered decisively (Reiners, 2017, p. 84).

Opportunities arise to take up students' unreflected notions about Nature of Science (NOS) so that learners can develop more realistic epistemological notions, train their critical awareness and develop appreciation of science (Hofheinz, 2010). The empirical and the theoretical basis as well as the provisional nature of scientific knowledge can be examined. How the status of observations, interpretations, models, theories, and laws can be considered is illustrated here by the example of a quotation from the "Unterirdische Gasarten": "Here is the point where one takes refuge in the hypothesis of a light substance bound to all combustible substances and to a light propagation through the thickest darkness; a hypothesis which, in so far as it establishes a mere possibility,

can hardly be regarded as an object of empirical chemistry!" (Humboldt 1799a, p.72-73).

In addition to studying the sources, a number of historical experiments were carried out in order to better assess the work and to gain starting points for the students' own practical-experimental work in chemistry lessons (figure 1). Thus, the historical observations can be made even more detailed, lively and interesting. References to this are described in detail elsewhere (Gröger & Wurm, 2019).

Figure 1: Oxyhydrogen gas eudiometer to determine the oxygen content of air by reaction with hydrogen

2 Light holder and rescue machine for miners

At the request of his mother, Alexander von Humboldt initially studied Cameralistics (economics). Later he changed his studies to mining. Thus, he could enter the Prussian civil service as a "mining academician" (Krätz, 1997, p. 32). In his professional field he was interested in geological, biological and chemical relationships underground. He considered, for example, what kind of influence the lack of sunlight or humidity as well as magnetic, electrical and other effects could have on the composition of the mine air. From a specific chemical perspective, he determined, for example, the oxygen content with a eudiometer (air quality meter) according to Fontana, i.e. via the reaction of atmospheric oxygen with nitrogen monoxide in a glass tube, and with a eudiometer according to Reboul, in which white phosphorus reacts with oxygen (Richter & Engshuber, 2014).

Humboldt wanted to improve the working conditions of the miners on site and so he developed a miner's lamp and an apparatus for rescuing miners ("respiration machine"). Both devices are designed to bring oxygen - to breathe or burn a flame - into the mine. From a chemical point of view, it is interesting to note that Humboldt is initially considering obtaining oxygen on site by decomposing saltpetre and manganese dioxide, but this is not feasible for cost reasons. (Humboldt 1799a, p. 249). Therefore, he planned the devices in such a way that one air supply is taken along (Gröger, 2019, Gröger & Wurm, 2019).

3 The “Anthrakometer”

Humboldt was also interested in the carbon dioxide content of the air in the mines. However, Humboldt described even more far-reaching interests: "In order to get to know whether on high mountains there is as much carbonic acid as in the valley, in oak forests as much as there is in fir forests; in order to investigate whether a toad produces more carbonic acid than a frog, it is necessary to be able to observe the smallest differences in air

shrinkage" (Humboldt 1799b, p. 86). Since Humboldt did not yet have a useful measuring method, he developed the "Anthrakometer", a measuring instrument consisting of a tube which is about 30 cm long, about 8-9 mm wide, bent at the bottom and ending in a sphere about 3.5 cm in diameter. The carbon dioxide content of an air sample is determined by its absorption in lime water (figure 2).

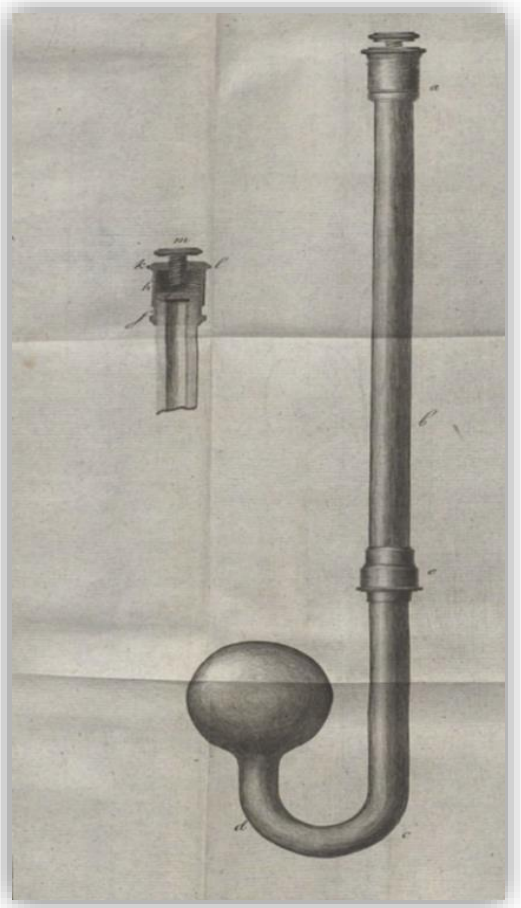

Figure 2: Humboldt's "Anthrakometer" (1799a)

Humboldt's measurements are clearly close to those to be expected in pre-industrial times. However, he comes to the clear and groundbreaking conclusion: "At first glance, it does not matter whether three thousand parts of carbon dioxide are more or less present in the air. But only at first sight! One thousandth part more makes a considerable mass in the unmeasured airspace, in so many thousand cubic miles of air - and this mass serves the plants as food [...]; it returns, provided by the animals, according to the laws of the eternal cycle into the atmosphere!" (Humboldt 1799b, pp. 115-116).

4 Joint research activities with Gay-Lussac

After his return from the expedition to America, Humboldt meets Joseph Louis Gay-Lussac in Paris. The two researchers become friends and work together to determine the oxygen content of the air as accurately as possible - with a view to Humboldt's earlier measurements, which were found to be imprecise. In describing their results, the two researchers reveal a foresighted insight into global interrelationships that is more obvious than ever in today's climate change: "If all geological facts agree to prove that the Earth is no longer what it once was, that very high mountains were formerly covered by water, and that the North nourished animals which now can only be found in the tropics, it can be foreseen that it will be of great value for the coming centuries if we accurately determine the present physical state of the Earth's body. For even if the greatest catastrophes which it has already suffered should not happen again, it would be possible that it would be subject to gradual modifications, which only become apparent after a long series of years; and in such a distance it might be of the utmost importance to now determine the great phenomena of nature, which could perhaps be variable, by precise observations in a reliable way … the intensity of the magnetic forces, the height of the barometer at the sea surface, the height of the sea, the mean temperature of any climate, and the relationship in the constituent

parts of the atmosphere". (Gay-Lussac & Humboldt, 1805, p. 38-39)

After intensive work with an audiometer designed by Volta, they come to the conclusion that Volta's measuring device provides very accurate results and that "the product of the combustion of hydrogen gas is always of the same nature" (cf. Gay-Lussac & Humboldt, 1805, p. 68). In this process, they are the first researchers to determine the volume ratio of hydrogen with oxygen to water to be exactly 2:1! They determine the oxygen content of the air with 21% very early and with high accuracy.

5 Other chemical works

During his time in the mountain service and the preparation for his large journey to South America, Humboldt is occupied again and again also with gas chemical measurements with his anthracometers and eudiometers. He investigates the air composition at sea and in different places and altitudes on land as well as volcanic evaporation. But he also uses wet-chemical methods to investigate waters, including potassium oxalate for calcium, barium salts for sulphate and calcium cyanide for iron (Hartke, Lehmann & Rienäcker, 1986). There is still a need for further research in addition to these investigations.

6 Conclusion

Humboldt's chemical work was essentially oriented towards environmental analysis. Humboldt has also made significant contributions to chemistry, particularly in cooperation with Gay-Lussac, through the accuracy of his work, his networked thinking and his farsightedness. He can also be regarded as a thought leader of current references in the climate debate.

It seems profitable to make Humboldt's chemical research a subject for teaching, not only for historical and theoretical considerations of science, but also with a view to current references to

climate change and independent creative experimentation on the part of learners. In general, interdisciplinary treatment is a good option. For inspiration, the Alexander von Humboldt Handbook (Ette, 2018, p. 106) contains 33 other scientific areas that Humboldt has dealt with, ranging from Ancient American Studies to geography and climatology to zoology.

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Matthias Weipert

Extracurricular learning locations in the historical perspective of general studies - the example of the Wendener Hütte

Out-of-school places of learning allow the encounter with sources, i.e. "original" and "authentic" objects from the past. Learners in the classroom normally do not come into contact with these objects, but rather with reproductions which cannot convey an impression of the size, the form, the feel etc. of the original whose vividness helps to give pupils an understanding of historical method. At the same time, an arranged place of learning provides the opportunity to question the alleged “originality” and “authenticity” of the object and thus to experience the constructed character of history.

The Wendener Hütte (cf. on the following: Löcken, M., Bartolosch, T. & Weipert, M. (2019)) is especially suitable for these central historical learning goals, especially since it enables the cross-perspective learning which is elementary for general studies.

The preserved ironworks in Wenden (Olpe district) operated between 1728 and 1866. After its closure, various companies settled in the buildings until the special historical value of the plant was recognised in 1969. Renovations started in 1977/78. Since 1993 the complex has been open to visitors. According to the typology of out-of-school, historical places of learning (Mayer 2007, Sauer 2018), we are dealing with a mixed form. The Wendener Hütte is both a historical site, i.e. a place where remnants of the past have been preserved, and an institution that serves as a reminder. On the one hand, the historical remnants are explained with albeit sparingly used information panels, and on the other hand they are contextualized in the museum (since 2007) and embedded in a historical narrative. In this way, the history of the site is consciously interpreted and exhibited for posterity. Two historical

learning goals can be combined with a visit to the Wendener Hütte. In terms of content, pupils can learn something about iron smelting and the connection between natural conditions and industrial settlements as well as the resulting regional differences in industrialization. In terms of methodology and theory, they can not only learn about the process of constructing history, but also experience it in a hands-on way.

The central components of the Wendener Hütte were the blast furnace and the hammer mill. Iron was produced here, initially pig iron from iron ore made in the blast furnace. This was very brittle due to its high carbon content and could hardly be processed further. The pig iron was reheated and shaped in the hammer mill to minimize the carbon content. Through this process, known as refining, iron was produced in Wenden that could for example be used to manufacture small iron parts. At the time of early industrialization, the Wenden ironworks was favourably situated, as the resources required for iron production - iron ore, water and wood (coal) - were available in the immediate vicinity or not too far away, and the location was also well-connected to supra-regional markets in terms of transport. Despite these favourable conditions, the Wendener Hütte had to close at the very time of high industrialization for three closely related reasons. Firstly, charcoal was replaced as an energy source by the much more efficient hard coal, and secondly, the ore could no longer be mined so easily in the region. This made expensive transports of hard coal and iron ore necessary which thirdly could no longer be carried out at competitive costs. The railway became more and more important, but the Wendener Hütte was located off the route that led to the Ruhr area. As a result, iron production in Wenden was no longer competitive and production had to be stopped.

The monument from the time of early industrialization is small and neatly arranged compared to later industrial plants and thus may surprise visitors at first. Today, it seems rather idyllic and contemplative. Therefore, it is important to first convey an impression of

how the former industrial plant looked and operated. This can provide important insights into the relationship between space and human use of said space, for which functionality is and was a central factor. If certain conditions and constellations no longer exist, a site becomes unprofitable and uninteresting with regarded to its originally intended use.

Thus, the place of learning allows us to learn a lot about (early) industrialization. However, it must also be understood as a construct which serves as a destination providing not only historical insights, but also an experience of nature. Against today's secluded and seemingly peaceful scenery, the dirt and noise associated with iron production are difficult to imagine.

Before visiting the Wendener Hütte, students should have basic knowledge about the early industrial extraction of iron. In order to get a feel for the place of learning, they then approach the ensemble of buildings like an archaeologist (i.e. without yet knowing the exhibition) and try to find preliminary answers to the following questions: What was produced in the Wendener Hütte and what resources were needed for it? Why was the Wendener Hütte founded at this location?

Afterwards, a visit of the exhibition provides the opportunity to test their hypotheses and to work on two further problem areas. On the one hand, the students are to think about why the smelter, which was actually operating successfully, had to close in 1866 (i.e. in the middle of the industrial "take-off" period). Secondly, their findings pertaining to regional history will be compared with the stories about industrialization told in primary school textbooks or internet sources (e.g. Kinderzeitmaschine).

In this phase, the students are asked to work out that both pig iron and wrought iron, i.e. heavy industrial goods, were produced in the Wendener Hütte ironworks, for which mainly iron ore, water and charcoal were needed. The supply of these resources was

secured at the site for a long time. Railway construction which was considered an essential prerequisite for industrialization in Germany was a death sentence for the Wendener Hütte, because it was now cut off from the favourable transport routes (both for the raw materials ore and hard coal and for the finished goods) and no longer economically viable. Students can understand that the industrial development varied by region and that processes at national level do not necessarily apply to specific regions. The construction of history thus also depends on which region is investigated.

A second opportunity for historical learning using the example of the Wendener Hütte will be briefly addressed, namely the insight that "authentic" out-of-school learning places are also constructions. For this purpose, the students describe their impressions of the Wendener Hütte at the beginning, i.e. before they have seen the exhibition, and spontaneously answer questions such as: What impression does the Wendener Hütte make on you? How do you imagine working at this place - strenuous - pleasant, loud - quiet, dirty - clean etc.?

Afterwards the students visit the exhibition and try to reconstruct the working conditions in the Wendener Hütte. They will come to the conclusion that the working conditions were very hard, but that there is nothing to be experienced or learned of this by looking at the buildings alone. The pupils consider and discuss ways and means of illustrative the working conditions with regard to the group of buildings.

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Mirko Schommer

Spatial Orientation - Competence expectations and common misconceptions based on map projections

Comprehensive geographical education is the prerequisite for participation in the ecological, economic, social and political coexistence of our globalized world. Therefore, the ability of spatial orientation, similar to reading, slicing and arithmetic, is now understood as an important cultural technique.

Spatial orientation requires the learning of various competences, which are already established in the initial school phase and specified in the further course of school education. One of these competences to be learned is the understanding and correct handling of maps. A lack of knowledge about the properties of map projections often leads to misconceptions about the contents displayed on the map.

A non-representative survey among students of the Universität Siegen shows, among other things, the difficulty of correctly assessing the size of individual countries and continents. However, simple tasks and examples in class can help to counter this and other difficulties at an early stage and to avoid misconceptions.

1. Introduction

Teaching geography means more than communicating country facts, irrespective if the content is taught in elementary or secondary school. Students should be empowered to find their way around their local, regional and global environment and to understand global relationships and systems.

The ability of spatial orientation requires different skills. The foundation for this qualification is already laid in the "Sachunterricht" (regular science, natural and social science in the elementary

school in Germany). The imparting of these competences can only be achieved if the teaching of geography is sufficient represented in the curriculum and the teachers have appropriate expertise. A non-representative survey among students of the "Sachunterricht" at the Universität Siegen about spatial orientation competence has shown, among other things, difficulties in using maps. A lack of knowledge about the properties of map projection often leads to misconceptions about the space represented.

2. Requirements for spatial orientation

The basic association that most people have with spatial orientation in a geographical context is to learn how to use a map and a compass and how to get from any starting point to a defined destination. However, this orientation in real space covers only one of the five competences required for a comprehensive spatial orientation in our world (Hemmer, 2016).

Tab. 1: Dimensions of spatial orientation competence (cf. Hemmer, 2016)

Dimension	Explanation
Basic topographical knowledge	Spatial orientation patterns and classification systems. For example: Names and locations of the continents, oceans, federal states, provincial capitals, knowledge of the global grid, structure of the natural environment
Classification of geographical objects and facts	Ability to describe the location of geographical objects in relation to other geographical reference units, orientation patterns and classification systems (rivers, mountains, states, etc.) and to depict them in sketches
Handling maps	Ability to read, evaluate and make maps

Orientation in real spaces	Positioning of the own location in the real space (map, compass, compass direction), descriptions of routes, orientation based on schematic representations
Reflection of spatial perception and construction	Knowing that spaces are selectively and subjectively perceived and the space representations (for example on a map) are constructed

3. Competence Expectations

The introduction to the ability of spatial orientation is part of the "Sachunterricht". The curriculum for elementary schools in North Rhine-Westphalia defines the corresponding competence expectations for the realm "space, environment and mobility", and for the following key aspects (Tab. 2).

Tab. 2: Competence expectations in the "Sachunterricht" for the realm "space, environment and mobility", exemplary for the key aspects "school and environment" and "place of residence and the world" (cf. Ministerium für Schule und Weiterbildung des Landes Nordrhein-Westfalen, 2012)

Key aspect	Competence expectation at the end of class 2	Competence expectation at the end of class 4
"School and environment"	- Students explore their way to school - Students know the school environment, as well as important	- Students use maps and orientation utilities for navigation
		- Students explore and describe structures of their own

	institutions in their place of residence - Students orient with the help of path and location sketches, - Students realize information signs and pay attention to them	habitant and of the region
"Place of residence and the world"	- Students know and name the spatial structure of their place of residence	- Students compare, describe and document natural and artificial characteristics
		- Students examine, describe and compare changes in geographical areas

The reading and interpretation of maps is given a high priority in the "Sachunterricht", as further geographical content can be developed on the basis of map competence. It makes sense to initially introduce large scaled maps with little detail and local reference and, with increasing knowledge, to develop more complex content and larger spatial areas. The pupils are taught that maps are always constructed and represent only a part of reality. The map always depends on the subjective point of view and the intention of the map authors (Spitta, 2016). Depending on the purpose a map is supposed to serve, contents can be presented in a generalized way, topics can be highlighted and distortions can be accepted.

In everyday life, we hardly notice the construction of a map, especially when it shows a standard representation that we encounter again and again in different contexts. Examples of this are the orientation of the maps to the north, Eurocentrism or the frequent use of certain projection types such as the Mercator projection. Misconceptions that arise from the characteristics of a selected map type can be discussed early and explained by using exercises.

4. Geographical misconceptions that can result from the projection characteristics

It is mathematically impossible to transfer the three-dimensional spherical shape of the earth geometrically exactly to a two-dimensional map. Therefore, only selected geometric properties can be represented realistically, other properties are distorted. We distinguish map projections according to their preserving of area, distance, direction or bearing. The representation is adapted to the respective purpose.

The lack of knowledge of map projections leads to a number of difficulties in working with maps and often promotes misconceptions about the shape of countries and continents and their spatial relationships to one another.

4.1 The equal-area representation of countries

A typical example of a map projection that leads to misconceptions regarding the true area size of countries is the cartographic representation of the world using the Mercator projection. Gerhard Mercator designed his famous world map in 1569 with the aim of ensuring safe navigation on the oceans. For this purpose, the map had to be angle-true. This made it possible to determine the course angle to be followed at any given point. Mercator achieved this, however, only with the compromise that the countries shown in the map were stretched in their latitude as well as in their longitude (Crane, 2005). Mercator's projection has gained acceptance and is used worldwide, including in a slightly modified

form for the Internet in the map services Google Maps and Open Street Map.

Among 169 students of the teaching profession at the Universität Siegen, it was determined, if there is a sufficient awareness of the extent of the distortions caused by the Mercator projection and if the actual area of a country is realistically estimated. In a questionnaire the following task was given: *"Look at the following world maps (Fig. 1). The Mercator projection used distorts the areas and the sizes shown do not correspond to the real conditions. How does the size ratio of the marked areas appear in reality?"*

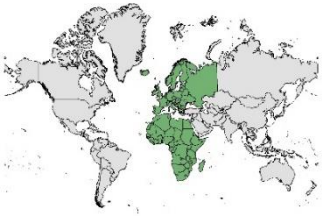
The evaluation of the survey shows that the majority of the participants have misjudged the proportions (see Fig. 2), the correct answers would have been 1 to 3, 4 to 5 and 1 to 4. The extent of the distortion was underestimated overall.

In order to avoid this misconception of schoolchildren and students, which can develop due to the distorted area representation of the Mercator map, various options are available. The simplest form is to work with the globe, since here the three-dimensional spherical shape enables a realistic representation. For school lessons, there are various internet sites offering templates for globes.

In addition, there are different equal-area map projections that can give the pupils a different picture of the world. However, as described at the beginning, the true surface accuracy of these projections is achieved at the cost of angle and length accuracy. Well-known equal-area map projections are the Gall-Peters projection and the Mollweide projection.

Wie ist das Größenverhältnis von Europa zu Afrika?

Europa	2	1,5	1	1	1	1
Afrika	1	1	1	1,5	2	3



Map 1

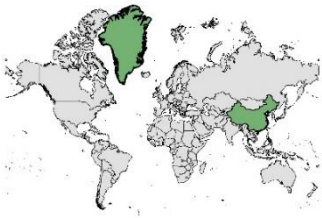
Wie ist das Größenverhältnis von Nordamerika zu Afrika?

Nordamerika	2	5	1	4	1
Afrika	1	4	1	5	2

Map 2

Wie ist das Größenverhältnis von Grönland zu China?

Grönland	4	2	1	1	1
China	1	1	1	2	4



Map 3

Fig. 1: From left to right: Query of the real size relations between Europe and Africa, North America and Africa, Greenland and China, represented by a Mercator projection (own representation, cf. Annette Kübler, EMW Missionshilfe Verlag Hamburg).

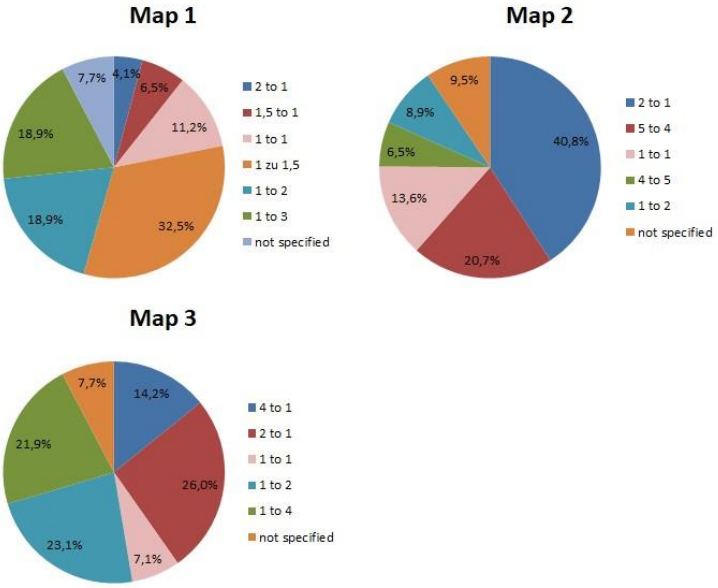


Fig. 2: The true size of the countries and continents in relation to each other was correctly estimated by 18.9% of students in Map 1, 6.5% in Map 2 and 21.9% in Map 3 (own representation).

An impression of the true proportions of individual countries or continents to each other can be obtained by using various cartographic Internet tools, for example on the websites "thetruesize.com" or "map-fight.appspot.com". On "thetruesize.com", individual countries can be moved within a Mercator projection so that the representation changes according to their latitude and the true proportions become visible (Schommer, Heck, 2019).

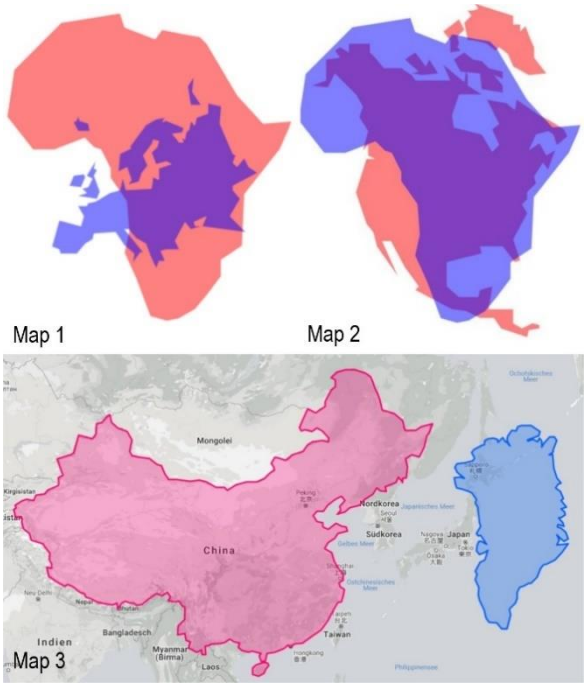


Fig.3: The real size ratio of the areas queried in Fig. 1. Map 1 and 2: Europe and North America compared to Africa (map-fight.appspot.com) Map 3: Greenland compared to China (thetruesize.org). By moving the countries to the same latitude (in this case to the real position of China) the true scale becomes visible.

4.2 Equidistant projection

Map competence includes the understanding of the map scale and the ability to calculate distance information from a map. In the dictionary of cartography, a map is defined by an associated scale (Wilhelmy, Hüttermann, Schröder, 2002).

The use of scales is already taught in primary school as soon as the pupils have learned the necessary mathematical prerequisites. Also with regard to the scale, knowledge of the properties of the map projection is useful to avoid misinterpretations. There is no

map projection that depicts the globe on a map in such a way that the real conditions between all locations and in all directions are true to scale. Even so-called equidistant map projections are only partially true to scale. In most cases, the scale is only true to scale along the intersection lines of the projection. The projection causes errors which become larger the smaller the scale of the maps is.

Again, it is a good idea to convey this in class through an exercise. On a small-scale world map, the pupils first measure the distance between two places and calculate the distance using the map scale. For this exercise, for example, the physical world map in a scale of 1:6,500,000 of the Federal Agency for Civic Education in Germany, which can be obtained free of charge, can be used (Fig. 4).

Fig. 4: Distance measurement between Berlin and Tokyo (own photo).

Then the results can be verified by measuring the same distance on a globe or on a PC, for example using the map programs Google Maps or Bing Maps. If the distance between Berlin and Tokyo is measured on this map, a distance of 12,350 km is calculated.

4.3 Conformal and gnomic projections

Another misconception can arise if a course angle (angle between the targeted destination and north direction) has to be determined from a map for navigation in real space. Also in this case the consequences resulting from the characteristics of the map projection are often not considered.

With the Mercator projection described above, the correct course angle can be determined. If the chosen destination is exactly west of the starting point, a constant course angle of 270° would have to be followed to reach this destination. Looking at a Mercator map, it can be assumed that it is sufficient to align your vehicle to this angle once at the start in order to reach your destination. Instead, a permanent course correction with the help of a compass is necessary to keep the western direction. This is because there is a significant difference between the compass direction once you have set your course and the constant tracking of the course angle.

This is illustrated by a simple thought process. The students are asked to answer the following question: "Imagine that you want to travel around the world from Siegen. Therefore you start exactly to the west and then do not change your direction. Through which countries do you travel until you reach your starting point again?"

Probably countries like Canada, USA or Russia are mentioned in response to this question. This shows that knowledge about the difference between a direction once taken and a constant course angle is not available or cannot be retrieved. If the route on which the countries mentioned are located is taken from the starting point, the compass direction changes constantly.

In fact, without course adjustment, the journey to the west would cross the equator west of Ecuador, cross Australia and approach its starting point again via India. In that case, every point of this line would be exactly west of Siegen.

West and east are defined by intersecting the reference meridian at a 90° angle. This results in a difference between the compass direction in which a target is aimed at and the course that you must follow to get there (Fig. 5).

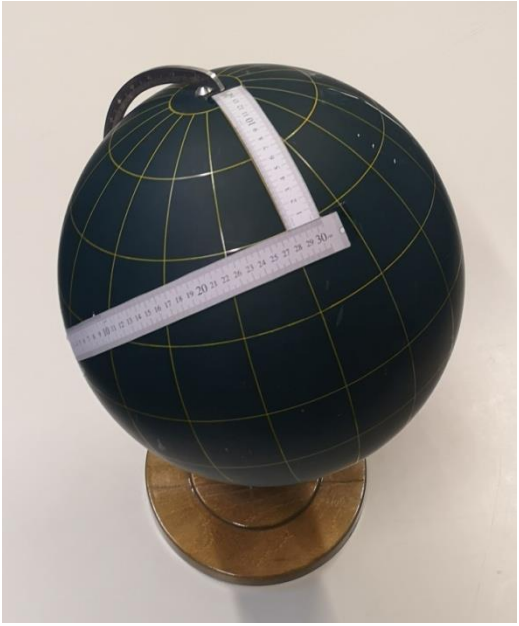


Fig. 5: The x-axis of the ruler points constantly west from the intersection of the meridian (own photo).

In a Mercator map, the constant course angles, in other words curves that always intersect the meridians at the same angle, are shown as straight lines, which leads to the misconception described above.

The correct direction in which you have to start in order to get from a starting point to a target point on the shortest way and without course correction can be determined on a gnomic map. In these maps there is no distortion at the point of contact of the

projection with the globe, but distortion increases rapidly away from it.

5. Summary

The lack of understanding of the different characteristics of a map projection often leads to misconceptions of the geographical contents displayed on a map.

A non-representative survey of students at the University of Siegen revealed difficulties in correctly assessing the size of individual countries and continents in relation to each other. The extent of the distortions on a map with Mercator projection was underestimated by the majority. For example, when comparing the area ratios of Greenland and China. Due to the increasing distortion of the Mercator projection with increasing latitude, Greenland is shown in a strongly distorted way. The correct size ratio (China is about four times larger than Greenland) was only recognized by 21.9% of the participants.

Further misconceptions often result from the insufficient understanding of map & space and a missing knowledge about the angle, length or directional accuracy of map projections. The use of globes, internet mapping tools and maps with different projection characteristics can prevent the manifestation of these misconceptions already in primary school.

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Sarah Gaubitz

Options for handling complex problems of global change from the perspective of primary school children

Complex core problems of global change such as the current extinction of species and climate change are already of interest to children of primary school age, as evidenced by survey studies such as the Geolino-UNICEF Child Value Monitor or the current World Vision Kinderstudie. Moreover, educational policy documents such as the Agenda 2030 call for an examination of these complex problems within the framework of Education for Sustainable Development (ESD) for primary schools. Thus, insights into the ideas of primary school children about possible ways of dealing with core problems of global change are relevant. Nevertheless, up to now, only limited studies have been available on the options for action that primary school children name for complex problems of global change that are relevant in the context of Sustainable Development. This question is one of the research topics within the study "Value orientations of primary school children in the context of Sustainable Development" (cf. Gaubitz 2018).

The findings of the study show that the interviewed children see an urgent need for action and perceive complex problems as controllable since they name a broad spectrum of options for dealing with them. One can deduce consequences for adaptive (primary) education in the context of ESD from the results of this study.

1. Introduction

At present, core problems of global change such as species extinction, soil degradation and climate change, as well as the associated interactions in our Earth system, threaten Sustainable Development within the planetary guard rails (cf. Rockström et al. 2009, 472ff.). In order to change these core problems towards Sustainable Development, major transformation is needed (cf. UN 2015,

1ff.). 17 Sustainable Development Goals (SDGs) have been developed for the realisation of Sustainable Development. In each of these goals, all three values of Sustainable Development (ecological, economic and socio-cultural values) should be explicitly taken into account (cf. UN 2015, 1). Furthermore, strategies for the realisation of Sustainable Development were formulated. In literature, three strategies are discussed for the implementation of Sustainable Development: the efficiency, consistency and sufficiency strategy (cf. Michelsen/Adomßent 2014, 34; Stoltenberg 2009, 6f.). These strategies can also be supplemented by the justice and education strategies (cf. Altner 2009, 79; Stoltenberg/Michelsen 1999, 48). These strategies will be briefly presented below:

The efficiency strategy pursues an optimised use of a resource, mainly by using technical innovations (cf. Hauenschild/Bolscho 2009, 40f.; Stoltenberg 2009, 6). In contrast, the consistency strategy intends to maintain the regenerative capacity of ecosystems and accordingly use resources only in the quantity and at the pace at in which nature can renew them (cf. Hauenschild/Bolscho 2009, 41; Stoltenberg 2009, 6). In contrast to the efficiency and consistency strategy, the sufficiency strategy focuses on the individual and his/her values (cf. Hauenschild/Bolscho 2009, 41). The aim of this strategy is to reduce consumption or resource use. Values such as frugality, thriftiness and renunciation are at the forefront of this strategy.

The justice strategy - in the sense of distributive justice - aims at reducing poverty and promoting social justice (cf. Stoltenberg 2009, 7). The education strategy is closely interlinked with the justice strategy. The United Nations already emphasized the outstanding role of education for transformation processes towards Sustainable Development in Agenda 21 (cf. UN 2015, 3), but even more so in the current 17 SDGs. For this reason, ESD is also one of the 17 SDGs, but it can also be seen as being at the intersection of all other goals, since ESD always has a significant role to play in achieving them.

Knowledge of such strategies, which falls within the area of environmental knowledge, represents, along with attitudes and behaviours, one of the interrelated components of environmental literacy, the central concern of ESD (cf. Paden 2012, 17). Künzli and Bertschy also refer to the competence of having knowledge of criteria for Sustainable Development (cf. Künzli/Bertschy 2008, 40), which are assigned to the competence area "acting independently" (ibid., 39). For this reason, it is highly relevant to the claim of designing adaptive teaching (cf. Helmke 2009, 231) to be aware of options for action and the knowledge contained therein regarding Sustainable Development of primary school children.

2. International state of research and research desiderata

With two exceptions (cf. Billmann-Mahecha/Gebhard/Nevers 1998; Hauenschild 2002), the few studies available on the above-mentioned topic area originate abroad (Finland, Slovenia, Portugal, USA, Brazil and England) and were partly conducted with pupils who were no longer of primary school age (cf. e.g. Aho 1984; Alaimo/Doran 1978; Požarnik 1995; Hauenschild 2002). Besides the fact that these studies are no longer up to date (several studies date back to the 1970s), it is objectionable that they show contradictory results (cf. Aho 1984; Nevers/Gebhard/Billmann-Mahecha 1998; Požarnik 1995). The approach taken in some studies can also be questioned as the interviewed children were already given options for action (cf. e.g. Alaimo/Doran 1978, 132ff.; Kahn/Friedman 1995, 1406). Furthermore, none of these studies analysed the respective option for action with regard to Sustainable Development.

In reference to the research desiderata described above, the following study posed the research question of what options primary school children have for dealing with complex problems of global change that are relevant in the context of Sustainable Development. In addition to the reasons already mentioned, findings in

this regard are also in view of the unsupported assumption that "[…] environmental knowledge, especially that which can be generally described as knowledge for action, is a prerequisite for environmental action [...] or that actual action must be preceded by a willingness to act motivated by various aspects." (Hauenschild 2001, 312), of high relevance, so pupils can shape transformation processes.

3. Study design

In order to answer these and other research questions, the dilemma interview was selected as survey instrument. The choice of this specific form of semi-standardised individual interviews has several reasons: This form of interview can be used for focusing on (content) questions such as conflict perception, options for action and the individual justifications of the interviewees (cf. Hopf 2008, 352; Keller 2001, 124) and the comparability of the results can be guaranteed. Another reason for selecting this form of interview is that the complexity of global core problems is presented in the dilemmas, since the entire value canon of Sustainable Development (ecological, economic and socio-cultural value dimension) can be integrated into them.

The global core problem of species extinction, resulting among other things from overexploitation, was chosen as an exemplary content for the dilemmas to be presented in the interviews. According to Rockström, the planetary guard rails have already been crossed in the area of extinction of species, making this topic particularly relevant (cf. Rockström et al. 2009, 472). The core problem of the extinction of species through overexploitation contains all three value dimensions of Sustainable Development and can hence find its expression in resource dilemmas.

The seahorse, which is threatened with extinction (cf. IUCN 2019), was chosen as the framework theme. The conservation of seahorses, of which approximately 2 million are caught and killed

annually and which are subject to the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora (cf. Rößiger 2003, 67), represents the ecological value dimension. The economic value dimension is represented by small-scale fishers in the Philippines and elsewhere and their families and children. Their survival is not secured without the capture and sale of seahorses (cf. ibid., 67f.). The socio-cultural value dimension is represented by a child who uses dried seahorses as a remedy, as is customary in Traditional Chinese Medicine (TCM), in order to be able to participate in activities with other children.

These three value dimensions are interlinked in this complex, multi-layered problem situation and were presented to the children in two dilemmas. Consequently, several perspectives had to be coordinated and the predicaments offered great potential for different value orientations, options for action and different argumentations. In order to grasp these aspects, the children were not only asked in the interviews to name the conflicting values within the dilemmas, but also to name options for action and justify all their statements.

A total of 12 girls and 12 boys aged between eight and eleven years were interviewed at the end of primary school. The interviews were between 40 and 60 minutes long. The resulting data were evaluated using a specific form of qualitative content analysis (cf. Kuckartz 2018).

During the interviews, all children showed a high level of motivation and willingness to deal with the complex dilemmas. This is shown, for example, by the questions asked by the children (cf. Gaubitz 2018, 185). This willingness is also called willingness to work by Steinke and represents a form of goodness (cf. Steinke 2004, 320). This underlines that resource dilemmas can also be used in technical and factual instruction to promote environmental literacy.

4. Selected results

Central results of the study reveal that the interviewed children not only recognized and named the resource objectives, but also reflected and assessed them comprehensively, linking the value dimensions of Sustainable Development. In addition, they listed a broad spectrum of options for action that could be assigned to the guidelines for Sustainable Development (cf. Gaubitz 2018, 179ff.). The latter point will now be reported in even greater detail. First of all, the range of options for action for dealing with the dilemmas that were named is shown. For this purpose, categories were inductively formed during the analysis. In a second step, the options for action named by the interviewed children were then deductively examined with regard to the guidelines for Sustainable Development (see introduction). The results of these analyses are also presented here in two steps.

4.1 Options for action

Basically, it becomes apparent that the values facing each other in the dilemma have been taken into account in the above-mentioned options for action. Moreover, the interviewed children not only formulated one option for action, but also weighed up different options. It should also be emphasized that the interviewed children also suggested options for action that represent compromises. For example, a compromise suggested is that only seahorses that are not pregnant (cf. Gaubitz 2018, 200) or only sick seahorses should be captured, since "they die when they are sick anyway" (Estelle in Gaubitz 2018, 200).

In the investigations of Voelker and Horvat as well as Billmann-Mahecha, Gebhard and Nevers, compromises are also sought in the proposed solutions. Voelker and Horvat find that children in grades 5-8 respond to the question "How do you think this problem could be solved?" (Voelker/Horvat 1976, 354), concerning environmental ethical problems, tried to solve them with

compromises: "Compromise Solves It" (ibid. 357). And also, in the study by Billmann-Mahecha, Gebhard and Nevers, they stated that compromises are formulated in the solution proposals of the children and young people questioned (cf. Billmann-Mahecha/Gebhard/Nevers 1998, 288).

Political measures in the form of bans and laws are mentioned as a second option for action (cf. Gaubitz 2018, 201). Furthermore, the possibility of taking action towards the research of new drugs that make the intake of seahorse powder obsolete reveals a belief in medical progress or technical optimism as a solution for the complex problem situation (cf. ibid. 199).

In addition to adequate options for action, two children also mention unrealistic options for action. For example, referring to the seahorses, one child suggests that they could hide (cf. ibid., 196) or in regard to the seahorse farmers that they should no longer catch seahorses (cf. ibid., 197).

Finally, it should be pointed out that the above-mentioned options for action are also partly taken up again at other points in the interviews, e.g. when expressing wishes.

4.2 Equivalence to Sustainable Development guidelines

The reconstructed options for action can be meaningfully assigned to the Sustainable Development strategies. In this way, all strategies are reflected in the children's options for action mentioned above. Some of the interviewed children's options for action and their assignment to the strategies of Sustainable Development are presented below as examples.

One example of an option for action was using the seahorse resource more optimally, so that one seahorse could be used for "100 children". This is in line with the efficiency strategy (cf. ibid., 203).

Another very prominent option for action was the creation of temporary protection zones for seahorses, which can be dissolved as soon as the population has recovered. It is also proposed that pregnant seahorses should not be captured as long as the offspring have not been born (cf. Gaubitz 2018, 204). These options for action can be assigned to the consistency strategy. Furthermore, options for action could be identified that can be assigned to the sufficiency strategy. The children interviewed refer to different stakeholders (sea-horse farmer, sick child, drug manufacturer). Some of the children also refer to themselves in their statements, such as a boy who would want to use the seahorse powder "economically" if he had to take it (cf. ibid., 205).

Another very prominent proposal is that of donations. Besides money, the interviewed children recommend donating food and water to the seahorse farmer families. In this context, NGOs such as UNICEF and Greenpeace as well as SOS Children's Villages are also mentioned. Ideas are also expressed, such as how to found an aid group yourself, become a sponsor or think up a (donation) campaign (cf. ibid., 195). This shows once again that the interviewed children perceive the situations as controllable and some of them perceive themselves as creators. Since such options for action focus on a more just distribution of money or goods, these options for action can be assigned to the justice strategy (distributive justice) (cf. ibid., 205).

Statements that aim at educating people about extinction of species and those aiming for an escape from poverty by attending school can be assigned to the education strategy. Such statements are rarely found (cf. ibid., 206).

It is also clear that there are value orientations of primary school children in the context of Sustainable Development behind the options for action that are discussed elsewhere (cf. ibid., 195ff.).

Overall, it can be shown that the children interviewed are able to develop a variety of options for dealing with the dilemmas which are in line with Sustainable Development guidelines. This ability corresponds to the competence formulated by Künzli and Bertschy of having knowledge of Sustainable Development criteria (cf. Künzli/Bertschy 2008, 40), which is assigned to the area of competence "acting independently" (ibid. 2008, 39). This means that the interviewed children already have environmental mental literacy at the end of their primary school years, and thus (science) education can build on this.

5. Conclusion

The reported results make it clear that the interviewed children perceived the complex problems as influenceable, as they were able to name a multitude of options for dealing with them. Furthermore, it could be shown that the mentioned options for action could be assigned to the strategies of Sustainable Development. In addition, dilemma stories proved to be suitable to enable children to deal with complex core problems of global change in a methodically and didactically guided way. These results encourage the application of dilemmas in (factual) teaching. Moreover, they promote the adoption of strategies for Sustainable Development in adaptive teaching as early as in primary school within the framework of ESD and thus provide new impulses for service learning, for example. For only in this way, children can be empowered to participate as responsible citizens in social life at local and global level, taking into account inter- and intragenerational justice in the sense of a great transformation for Sustainable Development.

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Swaantje Brill

Museum Field Trips in Primary School: An Approach to Children's Perspectives

This article presents my dissertation project, which focuses on museums in school field trips and asks how these environments are represented in the children's perspectives. As an introduction, considerations on pupils in the context of out-of-school learning are presented and museums are classified as places of teaching and learning. Subsequently, the necessity of dealing with the children's perspective is presented and my research approach with its methodological challenges is described. By using an example of a preliminary study with interviews, I will introduce an opportunity how to approach children's perspectives. The article concludes by a short discussion of what indications result for out-of-school learning and extracurricular museum education.

1. School Field Trips to Museums

According to Erhorn and Schwier, field trips in a teaching context are activities which are primarily concerned with opening up different spaces of learning in everyday life (cf. 2016, 7). The places are thus visited, since it is assumed that they connect curricular content with the children's worlds. The potential of such an out-of-school learning environment is primarily based on real or original encounters on site (from school as well as from museum-pedagogical perspectives). They enable to include teaching topics and learning experiences in authentic contexts, which are not possible in the school itself (Pech 2008, 71; Rupprecht 2016, 269; Sauerborn & Brühne 2012, 14). From a programmatic point of view, out-of-school learning locations shall overcome subject boundaries, enable methodological opening and promote motivation for dealing with the learning subject. In this way, such destinations become relevant as places of teaching and learning in the school sense.

Concerning pupil's field trips, it is necessary to ask whether these destinations can be alternatives to school or whether they are understood as destinations 'colonised by school' and 'subjected to the logic of school' (Budde and Hummrich 2016, 33) by the actors involved.

2. Museums as Places of Learning

Latest since the 1990s, museums have established themselves as extracurricular destinations for children, with their own educational qualities (Weiß 2016, 91).

Rupprecht (2016, 268pp) identifies three potentials of education in museums: encountering the original, the different learning environment of museums, and the acquisition of museum competence. We also find encountering the original in the aspects described above that are relevant for field trips to out-of-school learning locations from a school perspective. However, Rupprecht also emphasises the specificity of the museum itself and a museum competence closely related to it, which she describes as an ability to deal with museums and their ‚things' in a self-confident, critical and meaningful way. Among these 'museum things' are all the exhibits, the things of the displayed collection.

Exhibits in museums are representative of a subject or a learning content that needs to be uncovered (NRW-Stiftung 2001, 31, 35). A special characteristic of those 'museum things' is their decontextualization. Exhibitions, and in particular their pedagogical preparation, are specially arranged spaces in which exhibits are selected, prepared and staged. The original things are thus separated from their natural surroundings in order to finally make them accessible in museums. That implies: An exhibit has already gone through several steps of re- or decontextualization before it can be interpreted in its new museum context and furthermore be contextualized in terms of education.

A central characteristic of the learning environment of the museum, which distinguishes it from other classical primary school learning environments without an explicit educational assignment (such as forests as places of learning and experience), is the form of presentation in the museum and the offers that are considered relevant to school and prepared for museum education. This preparation is a genuine characteristic of exhibitions, because the acquisition of museum competence in the sense of Rupprecht seems to be supported especially with a critical examination of museum exhibits. It shows that a museum is a place that enables education, but also requires it (cf. Flügel 2009, 137). For a competent approach to the museum in the sense of a critical and meaningful examination of material culture as well as the museum as an object itself, educational field trips need to focus on this. The discussion points to an inner contradiction: The decontextualization is constitutive for exhibits but contradicts the assumption of school field trips with the aim of encountering the original.

In view of the ambitious assumptions about out-of-school learning location like museums and the simultaneously limited research basis for children's learning in museums, it seems reasonable to examine the opportunities of acquiring so-called museum competence in terms of a learning and teaching goal to be achieved. Previous studies are to be assigned to audience and impact research and aim above all at the further development or adaptation of didactic materials and concepts. Koch and Hille (2012) derive quality criteria for educational work in museums from the results of sentence completion tests on the exhibition of a children's museum. Bellmann et al. (2013) describe the development of educational material and play stations in museums by analysing video-graphic observations of children. Studies on the learning potential of experimental stations in science centres by Alberts and Giest (2011, 2012) show that activating primary experience itself does not lead to a deeper understanding of an learning object and that learning actions require inductional support.

3. An Approach to the Children's Perspectives

The interest in teaching and the aims pursued by the various actors (e.g. teachers and pupils) must not necessarily be equated (Wiesemann 2009, 181). Wiesemann describes children's own agendas that become clear in pupil actions and are manifested in everyday definitions of school routines - be it in the classroom, in the school building, in the playground or even outside the immediate influence of the school (loc. cit., 177). Scholz and Rauterberg (2008) emphasize this relevance of the distinction between perceptions and interpretations of teachers and students at field trips. For example, the museum as a museum pedagogical or school pedagogical space can be interpreted and developed by the various actors both in common and in different ways. Anderson, Piscitelli and Everett (2008, 257) have identified references to a differentiated agenda of children and adults in museum educational settings, which they categorize as "time", "content" and "mission".

Children's concepts of meaning and regulation (cf. Heinzel 2013, 708) are not necessarily the same as those of childhood images from which adults start and from which such educational programs are derived (cf. Honig 2009). By no means can we be sure that the children perceive the out-of-school learning environment as illustrative, for example, as it is proclaimed didactically (Baar & Schönknecht 2018, 40, 109) or that children find references to their everyday environment through the educational programs.

For researchers as well as for pedagogues in field trips, this leads to the claim that the assumptions and perspectives of the pedagogical actors and programs should be contrasted or compared with the children's ideas. In a first step, however, it is necessary to make the children's perspectives at the field trip accessible and reconstructible through research.

4. The Research Project

While the orientation towards the children's perspective is repeatedly mentioned in the context of museum pedagogical concepts (Sturm 2004; Kunz-Ott, Lefarth, Kindler & Stephan 2004), an exact analysis of these perspectives can be marked as a desideratum. Although numerous research results point to the existence of a difference in perspective and the associated challenges for didactic concepts, a precise analysis of children's perspectives on the learning location museum remains undone.

In my analysis of museums as out-of-school education locations in their most diverse forms and conceptions, I focus on children as actors and turn to the question of their modes of perception and access, which can be brought into interaction with museums (cf. Winderlich 2015, 5). The focus is led on the theoretical concept of the child as an actor (cf. New Childhood Studies). My research perspective is directed towards an active, competent and pragmatic examination of children (cf. Heinzel, Kränzl-Nagl & Mierendorff 2012, 14) with the learning environment of museums. In this context, I will pursue the research question of how the museum as an educational institution presents itself in the perspectives of children. The children’s activities of interpretation and giving meaning (Wiesemann 2009, 177) are the focus of my research interest.

The qualitative methodological approach is based on Grounded Theory (Strauss & Corbin 1996, Mey & Mruck 2009). The presented data is generated by qualitative interviews with children (Fuhs 2000) and evaluated in a combination of category building and sequence analytical reconstruction (Deppermann 2008, Wernet 2006).

In order to create access to children's perspectives and their activities of interpretation and giving meaning, however, methodical and methodological challenges must be considered in order to allow children to have their voice heard in the research situation and

to understand or reconstruct their perspectives (Heinzel 2013, 707).

Fuhs (2000, 89) cites the question of the truth content of children's stories and the generational difference between children and adults as methodological challenges that may be reflected in the survey situation and the evaluation process of qualitative interviews with children. In the sense of "new" childhood studies I understand children as competent 'constructors' of their lives (cf. Heinzel 2013, 707). The question of validity can therefore be taken into account in my research as it refers to the actual experienced and designed realities of children (loc. cit.).

The generation gap and the associated adult-centeredness in childhood research remain present as a research problem. I try to counter this problem with a methodic triangulation (Flick 2008) by successively developing and adapting the procedures of data collection[36] and the method of analysis in the sense of Grounded Theory.

5. "Why are there museums?"[37]

The following excerpt shows an interview sequence with a fourth grader who has already visited various museums. The museum visits she describes took place both in school and in her leisure time,

[36] The data presented in this article derives from a pilot survey of the above displayed dissertation project. As part of my later research work, I conducted interviews as well as observations of children at a museum in Cologne. In these detailed observations, not only linguistic interactions, but also physical and material dimensions can be taken into account in pedagogical offers of museums. The analysis of such reality-based situations takes pupils as actors in class situations and provides indications of their contributions to the local learning culture (Wiesemann 2009, 189f.).

[37] Translation of the interview question posed in German "Warum gibt es Museen?". The interview sequences were conducted in German, in this article they are displayed translatet.

so that the girl's explanations refer to experiences made in school-trips and extracurricular events.

When asked why there are museums, Marie explains (MS_1117_Z. 48-71):

> “To show people things that they can't see otherwise, but also special things, such valuable things, and you just want to show them to people, because otherwise perhaps only those who know the person in question well know it, and they want to show it to the public a bit, I think (...). For example, someone who can't move so well and just can't travel around the world and then he can (see/experience) things, like a giraffe that only exists where you have to travel from here, or in the zoo. But you don't see them like that in the wild and then you can look at them quite well.” [translated from German by S.B.]

Marie refers to the opportunity of getting out of the daily routine by visiting a museum ("someone who can't move so well and just can't travel around the world") in order to get to know other places. Through the museum, it is given access to new or foreign spaces. In addition, Marie describes that expert knowledge is made available to a broad audience, "the public" ("to show it to the public a bit"). For museum visitors, the exhibits enable a close look ("you look at them quite well") at the phenomenon, which only becomes accessible through the museum activity of displaying ("to show people things"). Her description corresponds to the original function of museums and the activity of museum communication. Thus, Marie names a description of the place of learning that is also found in the programmatic presentation in the discourse on education in schools and museums. The extent to which Marie's attributions would also show up in practice remains unanswered by the interview sequence. The interpretive process, which shows itself as an in-situ activity at the museum, I encounter by carrying out observations of children at museum field trips.

6. Conclusion and Outlook

Moments of children's involvement with and interpretation of the out-of-school learning place are mapped on the basis of the data. From this, indications of possible potentials of the learning locations can be gained.

In the qualitative interview analysis to children's perspective on museums, reflections on visitor orientation and access to cultural and aesthetic experiences can be highlighted as children´s approaches. In the coding, however, references to school characteristics that are (re)produced by children to the out-of-school environment are also made clear. Whether these codes also manifest themselves in the practices of the actors on site (in observed museum visits), and to which extent museums in school field trips (e.g. 'museum as an out-of-school learning environment' or 'museum as a learning environment itself') are produced, remains unclear at this point and will be investigated in the further course of the research through observations in museum visits.

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Urs Gießelmann and Uta Birkhölzer

The “Hauberg” as an extracurricular learning location

1. History

More than 2500 years ago there was a big forest all over the Siegerland. It consisted mainly of beeches and only very few other trees. Then the Celts came and found iron-ore on the ground and that`s why they settled there.

They knew how to produce iron out of the iron-ore in special furnaces and so they made iron and forged it.

These special furnaces can be found in lots of places in the forests of the Siegerland.

In the “historical Hauberg” such a furnace was rebuilt and people tried to make iron like the Celts. But this is difficult because the Celts didn`t write down how they did it and so it’s trial and error.

But what is sure, is that the Celts needed a lot of wood for their work and after several hundred years there was no forest left. And also not much iron-ore on the surface, that could be found easily.

So the people went away, only very few stayed in the Siegerland and a new forest could grow – a beech forest like before.

In the Middle Ages new people came – the Francs. They also wanted to have iron and they began mining. They had new and better ovens and furnaces to melt the iron-ore and produce iron. But they also needed lots of wood and again the forests disappeared.

Therefore, in the 15th century the sovereigns feared to lose their income of the iron industry and began to rule the management of the forest. In 1562, Count Johann zu Nassau enacted the “Wald-

und Holzordnung" which ruled nearly everything accorded to the forest. The "Haubergswirtschaft" was developed and continued with only slightly changes until the 20th century.

Here in the "Historical Hauberg Fellinghausen" we try to show how people in this time managed the forest.

In 1961 the railroad from Siegen to the Ruhrgebiet was finished and hard coal could be brought easily to the Siegerland. That`s why the charcoal lost its importance and the intensive forest management of the Hauberg to produce sustainable large amounts of wood was no longer necessary to its former degree. For some decades the bark of the oaks for tanning was the most valuable product of the Hauberg. In and shortly after the wars in the 20th century the Hauberg was again for some time necessary for survival, but after that all the agricultural and industrial uses vanished and only the firewood remained.

2. Ownership

In the Siegerland most of the forest is owned by forest commons. These are cooperatives of members of a village, which own the forest together and have only ideal parts of the Hauberg – like shares. For the work in the Hauberg the shares have to be transformed into real parts of the ground. The whole area of the forest common is divided in about 20 parts and every year the owners work in one of these parts. This part is shared out between the members of the forest common according to their shares. The areas to work at are marked with small poles with the families notch at the boundaries.

Normally the dividing took place in February after the melting of the snow.

3. The work in the Hauberg

In March, people began to chop down the birches (apart from some seed-trees) and other trees and bushes. The oaks that should be debarked kept standing until May.

The trees were chopped with an axe. It was important to cut the trees deep at the ground to use all the wood. The stumps had to be smooth and sloping, so that the rain could run off and the stumps didn`t foul. The wood was mainly used for charcoal production.

The brushwood and the branches were chopped with the chop knife (Knipp) and bundled up. The bundles were called “Schanzen” (Figure 1) and were used in the communal baking houses in the villages – to spare wood and to reduce the danger of fire.

Figure 1: “Schanzen”

In May, the oaks were debarked with a debarking spoon (Lohlöffel) (Figure 2) while they were still standing. So the bark could dry hanging down the trees. The dried bark was used to tan the skins of the cattle to produce a very hard and enduring leather.

Afterwards the wood of the oaks was also chopped down and used in the charcoal kiln.

Figure 2: "Lohlöffel"

Now there should come coppice shoots out of the stumps to renew the forest (Figure 3). The forest was so important that it was not allowed to clear it to make fields or pastures. That is why the fields and pastures were in the forest.

Figure 3: Coppice shoots

In the area where the trees had been harvested, now the rest of the vegetation (grass und herbs) was burned and the ground was prepared with hoes and ploughs.

In June after the last frost, people could sow buckwheat. They had to harvest it in the end of September before the first frost. Rye could be sown in August or September and be harvested the next year in August.

After sowing the seeds were covered with some earth. Normally the members of the forest common did it together with the help of a special plough – a Hoach.

While harvesting everybody had to take care not to hurt the coppice shoots. People were ordered to take a sickle - a scythe is not allowed. The rye was bundled up to sheaves. 9 sheaves are put up in a circle and the 10th is put over the others as a kind of hat. So the rain can run down on this “knight” and the rye can dry. After 1 or 2 weeks the grain was threshed, later grinded and then people could bake bread in the baking houses.

After the agricultural use the coppice-shoots could grow for another six years without being disturbed. Then the members of the forest common used the Hauberg as a pasture. They brought cattle and sheep to eat the grass and the herbs between the trees. A shepherd should herd them and make sure that the animals didn`t eat the coppice shoots. In most forest commons goats and pigs were not allowed, because they made to much damage.

4. Charcoal

The charcoal burner made charcoal of the oak and birch wood in a charcoal pile. First, he built a shaft from poles of about 1 m length. Around this shaft he laid the other wood in the shape of a half dome. Then he put grass and branches of spruces onto the pile and covers it all with soil.

He put some glowing wood into the shaft and shut it with a cover. Now the charcoal burner had to pay attention that the wood didn`t catch fire and only glowed. For that he made holes into the pile or closed them according to the weather conditions and to the progress of the glowing.

The charcoal pile in the historical Hauberg takes about 10 days until it`s ready, a bigger one needs more time.

When the carbonization was finished the charcoal burner and his helpers uncovered the pile and carefully took out the charcoal while extinguish it with water so that it won`t catch fire in the end.

The charcoal was used in the iron industry, today people take most of it for barbecues.

5. Living community in the Hauberg

Because the Hauberg is a different kind of forest, it has also a different kind of living community. There are special grasses, herbs, birds, butterflies, beetles and other insects who like to live in the various stadiums of the Hauberg. So the Hauberg causes a higher variety of species in the area and homes some rare creatures.

6. Hauberg as a place of learning outside from school

In the Hauberg pupils can learn a lot of different things. It begins with the history of their home. They can imagine how their ancestors lived centuries ago. They can try to use the old tools and do some of the work in the Hauberg.

They can also learn about the functions of the forest. At the example of the Hauberg it is easy to explain the productive function (use of wood, place of work, income and food source etc.), the protection function (protection of climate, soil, water, species etc.) and recreation function. They can see the Hauberg as one of the earliest sustainability systems and discuss this for today so important principle.

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This proceedings volume gathers papers presented at the symposium "Cultural Appropriation of Spaces and Things" held in Siegen, Germany in October 2019.

All over the world, children are confronted with an increasingly complicated and fast-moving world. Children need elementary cultural techniques and skills to shape their own lives and enable them to find individual interpretations of meaning. In addition to the acquisition of classical cultural techniques such as arithmetic, writing and reading, the competent handling of spaces and things – through manifold processes of appropriation and reflection – is crucial. It forms the basis and prerequisite for the development of competences or abilities that are suitable for understanding the dimensions, the complexity and changeability of their world and enable them to critically deal with associated problems and find appropriate solutions.

The aim of the conference was to find suitable ways for children all over the world for a methodically and didactically guided examination of their natural, social and technical environment. At the same time, the aim was to achieve a mutual enrichment of monodisciplinary research accesses. It also included a self-critical reflection of one's own culturally shaped approaches of research.

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