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Early Scientific Education

by Mirjam Steffensky

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ABSTRACT

Science is one of the educational fields addressed at childcare centres. Although there is a consensus regarding the overall goals of early scientific education, it is unclear which topics and activities should be covered and/or applied in practice, and this can be challenging for early childhood education professionals. This paper investigates which features of science-specific activities and interactions are important in order to initiate and support children's learning processes.

STRUCTURE OF THE TEXT

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1. Introduction

Scientific phenomena in the everyday environment

Children experience and observe scientific phenomena in various play and routine settings, both indoors and outdoors. One example is when a four-year-old child is constructing something with building blocks and keeps testing how far a block can be pushed out over another one without it falling down. This exploration has much to do with the physical concepts of "balance" and "forces", even if these terms have no meaning at all for the child. Scientific phenomena often provide children with an accessible introduction to science. Children can experience many of these phenomena using different senses; they can also investigate in a more reflective way and develop their first ideas on the subject. To do so, children need opportunities to have such (reflective) experiences and (further) develop their ideas. The goal of educational and learning opportunities like these is not for children to develop a scholarly approach; rather, it is to develop children's curiosity and motivation to engage with science; to encourage them to observe phenomena; and to come up with ideas that can be taken up and refined later over the course of their educational development. One such example is the distinction between animate and inanimate things.

This paper aims to motivate the reader to actively engage with the educational field of science because scientific education represents an important and exciting introduction to the world and to culture. The text is based on a WIFF[1] expert report, which describes the subject in more detail (Steffensky, 2017). This paper will address three central questions: first, what science is; second, what the goals of early scientific education are and how they are established in the German federal states' education plans; and third, what is important for the quality of scientific educational and learning opportunities.

2. Early scientific education

2.1 The scientific domain

No clear definition of what science is

Although no one would doubt that science is an important domain (branch of knowledge), there is no consensus regarding the question of what science actually is (Osborne et al., 2003). It is common to find lists of characteristic features (University of California Museum of Paleontology 2017). Science is said to:

- usually use empirical methods;
- be evidence-based;
- be influenced by social and societal factors;
- approach discoveries critically and sceptically, in order to be able to correct and possibly further develop them.

1 WiFF stands for Weiterbildungsinitiative Frühpädagogische Fachkräfte, a further training initiative dedicated to early childhood educators.

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Not everyone agrees about the importance of some of these characteristics. For example, "objectivity" is sometimes also named as a feature of science. Yet at the same time, the "objectivity" of science is seen as limited, because the scientific interpretation of data is always influenced by the theoretical frameworks and expectations of the scientists involved.

Science describes and explains nature

The aim of science is to describe and, above all, explain nature. Here, "nature" includes animate nature (biology) and inanimate nature (physics, chemistry well as some aspects of geography), covering very diverse areas and orders of magnitude such as subatomic particles, processes within the human body or reactions that take place on the sun.

There is broad agreement regarding two central elements of science: namely, that there are, on the one hand, concepts, theories and laws and, on the other, the processes and methods with which these are generated, expanded, changed and revised. Both elements are essential for understanding science, and accordingly represent central building blocks of basic scientific education.

Core concepts

Many people perceive science as a collection of separate facts that cannot be brought together to form a coherent picture. For this reason, science often seems particularly difficult and opaque. In order to tackle this problem, many school curricula are built around a few central, core concepts. These can be explained across different topics and contexts, and are relevant to both inanimate and animate nature. For example, energy is not only a central factor in the description of ecosystems (animate nature) but also in that of chemical reactions (inanimate nature). Figure 1 gives an overview of core concepts and gives some related example questions that children could investigate.

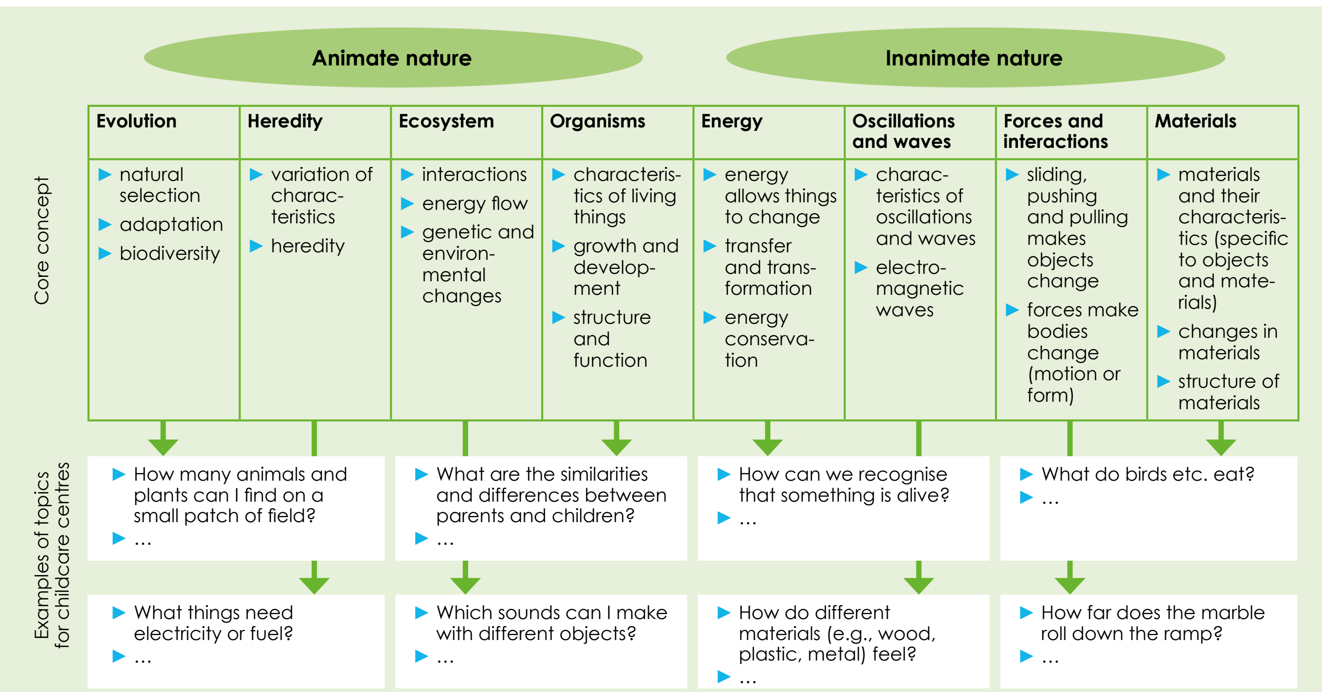

Figure 1: Core concepts in science (cf. Steffensky 2017)

Cumulative development of core concepts

Core concepts provide a basis for connecting and structuring separate facts and topics (Harlen 2015). Accordingly, these concepts have an important role in developing knowledge that can link various topics and is not limited to specific contexts. However, this does not mean that these concepts would be suitable topics to discuss overtly with children. Some of the aspects shown in Figure 1 (usually) play no role at all in early scientific education, such as electromagnetic waves or genetic changes. An understanding of these core concepts builds up cumulatively over the course of a child's education, from the childcare centre (Kita) up through school. However, an underlying knowledge of these concepts can be important for education professionals in order to facilitate learning opportunities and create connections between individual, scientifically relevant situations.

From "small" concepts to core concepts

For instance, characteristics of objects or materials (matter) can be observed in distinct situations that are often not connected but can be related to one another in terms of materials and their characteristics ("Do you remember what we found out about metals recently?"):

- *Metal is solid and not liquid*
- *Metal (usually) feels hard*
- *Metal often gleams slightly*
- *Metal does not usually have a specific smell, unlike wood, for example*
- *Metal objects that are not hollow will sink*
- *Metal does not burn – such as a firedish*
- *Metal is not soluble in water*
- *Some metal objects rust*
- *Some metal objects are attracted by magnets*

Observing and measuring in childcare centres

As mentioned above, having the knowledge and skills to generate scientific discoveries is a key part of science. The focus here is on core ways of thinking and working. It is important to have both the ability to use these ways of thinking and working and also some knowledge about these processes.

Knowledge about ways of thinking and working

Knowledge about observation includes aspects such as:

- *Observation is a targeted process.*
- *Observation can involve various senses, e.g., hearing and touch.*
- *Sometimes we need tools to help with observation, e.g., a magnet or a magnifying glass.*
- *Different observers can observe things differently, e.g., outdoor temperatures.*
- *Measuring is used to quantify observations.*
- *…*

Scientific ways of thinking and working include, for example:

- Observing and measuring
- Asking questions and making assumptions
- Comparing and classifying
- Planning and carrying out trials and experiments
- Analysing data
- Interpreting and drawing conclusions

Scientific ways of thinking and working

Individual ways of thinking and working are closely linked and often described as a cyclical, cumulative process (Pedaste et al. 2015; Leuchter, 2017; Sodian & Mayer 2013, Figure 2). That is because the result of this kind of process can lay the foundation for new cycles of hypothesis development and testing.

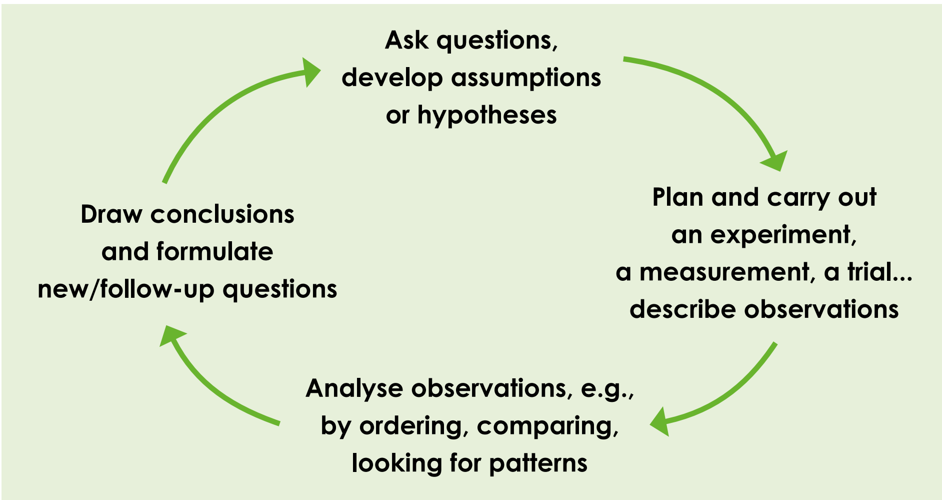

Figure 2: Research cycle (Steffensky 2017)

2.2 Goals of early scientific education

Multidimensional goals

There is a relatively broad consensus regarding the overall goals of early scientific education, which relate to a variety of parameters. They include multisensory experiences, early basic knowledge, motivation and interest as well as confidence in one's own ability to discover things (e.g., Trundle & Saçkes 2015; Samarapungavan et al. 2001). These core objectives are addressed in Germany's federal states' education and orientation plans for childcare centres and can also be identified as educational goals at primary and secondary school level.

Multisensory experiences

Right from early childhood, children gain their first, basic experiences of dealing with objects, living things, situations or phenomena. These encounters provide important introductions to the world. Thus, diverse experiences involving all the senses allow children to form their first categories – e.g., recognising that something is alive – with which they make sense of the world. For older children transitioning to primary school, such experiences are also important for the development of early scientific knowledge and interest. This is based on the assumption that cognitive progress – in terms of thinking, remembering and recognising – always occurs in tandem with physical perceptions and actions (e.g., Barsalou 2008). Sensorimotor and cognitive development are therefore closely linked.

Diverse, repeated experiences

In order for children to have these fundamental experiences, they must have access to appropriate experiential spaces and opportunities. Active exploration and physical perception of natural phenomena are of primary importance here. One example is when children repeatedly try to grab hold of the water in a bathtub, thereby experiencing a liquid state for the first time, even if they do not yet know what the term "liquid" means; or when they touch a stone bench and comment that it feels cold; or pour sand between different-sized containers and realise that some contain "only a little" or the sand overflows; or when they observe that water makes the sand darker. Often, experiences are gained in passing and in playful settings and are not necessarily perceived as explicitly scientific experiences, even by adults. Such experiences may be implicit or reflected upon, such as when a parent or an early childhood education professional talks to the child about it ("the water keeps slipping through your fingers"). It is difficult to assess whether all children perceive such sensory experience opportunities in a conscious way. It is assumed that they need varied and repeated encounters with nature in order to discover different aspects of it. Socially shared experiences can also be helpful for provoking conscious perception processes. However, experiences with nature do not automatically promote the development of scientific interest or knowledge. This requires opportunities to reflect upon experiences and observations (using all the senses). Early childhood education professionals can foster this reflective process by, for example, asking questions, pointing out

Implicit and reflective experiences

new things or consciously linking new observations with existing knowledge and experiences.

Making connections

Early scientific learning processes aim to foster fundamental everyday knowledge in terms of an initial awareness of correlations, allowing children to formulate relationships between states. This includes, for example, statements such as "the water starts to bubble when we heat it up", or "because the tortoise likes to be warm, it often goes into its glasshouse". It is partly about simple "if…then" or "the more…the more" relationships, such as "if the sun shines, the laundry dries faster", or "the further the building block juts out, the more wobbly the tower becomes". The recognition of such relationships has the character of an explanation for many children (and adults) – even if from a scientific perspective it is not an explanation but a description. Often, this initial everyday knowledge is still strongly related to concrete situations and not generally applied. As a rule, a number of experiences in slightly varied settings are required in order to apply this initial knowledge more generally. This early knowledge cannot be clearly separated from the ability to describe phenomena verbally. When a child describes the melting process, he or she must know terms such as melting, solid, liquid (or becoming liquid, such as turning into water, squishy, hard, etc.), and at the same time have an idea of the concept of melting in the sense of the melting process (a solid object becomes liquid).

Knowledge strongly linked to concrete situations

In addition to knowledge of phenomena, concepts or theories, scientific education also encompasses knowledge of the nature and inception of scientific discoveries. This is based on an understanding of scientific ways of thinking and working, as well as on epistemological factors (Bell & St. Clair 2015; Osborne et al. 2003), such as

- Scientific knowledge is (partly) limited and provisional, e.g., understanding of threats to health.
- Scientific knowledge is not complete – it is continuously(Fleer, 2017) developing.
- Scientific knowledge arises from the interpretation of data and observations. The same data/observations can lead to different interpretations.
- Scientific knowledge requires human creativity and involves a variety of methods. There is no standard method and no standard approach.
- Scientific knowledge emerges in a social and cultural context and is also influenced by this.

Suitable topics

Even if one can find a broad consensus regarding these overall goals of early scientific education (experiences, underlying knowledge, motivation and so on), there is no clear agreement in the education plans or in didactic materials about whether specific topics should be focused on and, if so, which topics they are and the extent to which they should be covered. In any case, a clear definition of suitable or less-suitable content hardly seems possible. Many topics are very complex and demand a great deal of prior knowledge if they are to be understood in scientific terms, which makes them seem less appropriate for childcare centres. At the same time, children encounter them in many everyday settings and, in that sense, they seem very appropriate. For example, in order to explain magnetic forces you need sophisticated particle models; yet children encounter this phenomenon in many everyday settings (magnets on the fridge, on locks, on a wooden toy railway, etc.), so it does not make sense to ignore these observations, which interest children. The complexity of the phenomenon is therefore not a suitable selection criterion. It is important to think about what children can discover about a topic, where they encounter a phenomenon and whether they can develop their own explanations. If we keep to the example of magnetism: here, with repeated encounters and exploration, many children succeed in realising that "many metal objects stick to the magnet" (interaction between objects and a magnet) (Steffensky & Hardy 2013). In contrast, the magnetic poles (interaction between two magnets) are often puzzling for five- or six-year-old children; these poles can be confused with the plus and minus poles of a battery, and in everyday life the north and south poles of a magnet are often not specifically marked (e.g., a wooden toy railway) or are not even recognisable (e.g., fridge magnets). For this reason, familiarity with the phenomenon (attraction and repulsion) is at the forefront here, rather than the development of an early explanation of the phenomenon, which can be covered at various points during the subsequent primary school years.

Discovering phenomena rather than simply explaining them

Science in the federal states' education plans

A comparison of education plans also reflects this lack of clarity. Some education plans (e.g., in Saxony-Anhalt) are mainly collections of examples of experiences and activities that children enjoy ("children crumble dry earth, let sand run through their fingers, knead clay, layer stones on top of one another and throw clods of earth"). Other plans, such as the Hamburg education plan, formulate competencies (e.g., "understanding the changes of season"), while some education plans set out concrete topic areas. The Bavarian plan contains the topic of "getting to know the characteristics of different materials: density and physical states (solid objects, liquids, gases)". Other than that, there are mainly generalised references to important experiences with nature. These differences cannot be attributed to state-specific factors alone – school curricula, for example, are far more homogenous throughout Germany. The different approaches in the education plans demonstrate the lack of consensus regarding the practical implementation of early scientific education. Some of the topics that are addressed, such as density, are also included primary school curricula and to some extent in later stages of education. Here, topics are repeated, but it is difficult to recognise which aspects are added or covered in more depth – which is frustrating for learners.

In terms of knowledge about science, it is also generally not possible to say that only specific ways of thinking and working are particularly suitable for childcare centres or can be initiated effectively by them. The reason for this is mainly that each of the ways of thinking and working can vary significantly in terms of complexity, and therefore has to be adjusted according to age. In a familiar context, where a child has already gained some experience and possibly prior knowledge, he or she can establish an assumption – while in a completely new setting, he or she can only guess, but not express any reasoned assumptions.

Suitable ways of thinking and working

From the perspective of integration with everyday life, ways of thinking and working such as comparing, ordering or measuring lend themselves particularly well, as children are familiar with many everyday settings where they can experience these processes: for example when collecting, tidying and weighing. At the same time, children – with help, if needed – can also learn about approaches that are less familiar to them. For example, in familiar contexts, five- and six-year-old children can carry out systematic experimentation where factors that are not of interest are kept constant (control variables), but it is not easy for them to learn this (cf. Croker & Buchanan 2011). If the goal is to find out whether salt dissolves more rapidly in warm or cold water, in a controlled experiment one would only change the water temperature, while other possible influencing factors such as the amount of salt or water, stirring, type of salt (coarse or fine), etc., would be kept the same. In the same way, early systematic comparison can be introduced within childcare centres, for example, when playing with marbles: in order to find out which marble rolls furthest, they have to be released at the same point, otherwise it is not “fair”.

Thinking about how scientists make discoveries

Regarding the epistemological aspects, which initially seem rather difficult, childcare centres can also lay down foundations for further development during the child’s educational trajectory. Children discover that the same thing can be seen in different ways: for example, when describing the taste of an apple, perceiving colours, or feeling temperature with their hands. They recognise that even scientific observations are, or can be, subjective. Other contexts are useful in order to clarify that observations or findings can be interpreted differently. For example, early childhood education professionals can talk to children about how scientists manage to find out about dinosaurs (which of course we cannot see in real life any more), and how there can be different interpretations of how dinosaurs’ bones would have fitted together. In addition, discussion of the epistemologically relevant question of what can and cannot be explained by science is encouraged through questions such as: “Which came first, the chicken or the egg?” (Michalik et al. 2014, 34).

2.3 Supporting scientific learning processes

Cognitive support, a factor in process quality

The quality of educational opportunities is critically dependent on the quality of children's interactions with their material and social environment, which is called process quality. Process quality includes aspects that are not specific to a particular field, such as emotional support, as well as aspects that are more strongly linked to a particular field, such as cognitive support (cf. Pianta & Hamre 2009)[2]. The goal of cognitive support is to open up the possibility for children to begin and maintain insightful learning processes. Central to cognitive support are verbal interactions amongst children, or between children and education professionals, during which children are encouraged to engage with a subject in more depth. In-depth engagement includes, for example, the ability to ask questions, express ideas and engage with the ideas and questions of others (cf. Alexander 2017; König 2009; Bransford, Brown & Cooking 2000). Children are thus actively involved in these interactions, and their theories, ideas and perceptions are starting points for longer negotiation processes in a group setting. Dialogues of this kind are also referred to as sustained shared thinking (cf. Hopf 2012; Siraj-Blatchford et al. 2002). In order to adapt the complexity of such stimulating and cognitively challenging learning opportunities to learners, and to help learners take the next steps in their thinking – in terms of the zone of proximal development (Vygotsky 1978) – additional scaffolding measures are important (Wood, Bruner & Ross, 1976). The goal of these is to reduce the complexity of the situation, so that cognitively challenging learning opportunities can be mastered and used independently by as many learners as possible in different conditions. One example of scaffolding is giving support by using structuring techniques in conversation, where relevant statements or insights are emphasised in order to focus the attention of learners. These generic characteristics of cognitive support play an important part in learning processes across very different areas, although they have to be defined in more detail for each specific area (cf. Klieme & Rakoczy 2008).

Challenging and activating cognitive skills

Structure and support

Intuitive perceptions

In the context of scientific learning, intuitive perceptions play a prominent role. Children, like adults, develop their own explanations for many scientific phenomena, which do not necessarily match the scientific viewpoint. For example, many children (intuitively) assume that things that are light will float on water, and are surprised to see that a sewing needle sinks. Or they explain the disappearance of puddles as being entirely due to water seeping into the ground, and do not take account of the process of evaporation (water goes into the air in the form of a gas). The prevalence of such intuitive perceptions means that opportunities to explore one's own perceptions, become

2 More comprehensive descriptions of process quality and further quality parameters can be found in Wadepohl (2015) or Steffensky (2017), as well as Kalicki, Wolff-Marting & Pestalozzi – Fröbel Verband e.V. (2015). Here, the focus is on stimulating interactions in a scientific context.

conscious of them, and be encouraged to question them, are particularly important (cf. Vosniadou et al. 2001). This also includes engaging with contradictory evidence or counterarguments in order to develop ideas further, if appropriate. For example, many children think that when a cold bottle mists up, the moisture must have come from inside the bottle ("the water sweats out because there are very tiny holes in it"). Children can then think about it and try out the following:

- what happens if you take the empty bottle, without the liquid, out of the fridge and put it into the room and see whether the bottle still mists up
- whether the liquid outside the bottle tastes like the liquid inside the bottle
- why the bottle doesn't "sweat" if it was not in the fridge beforehand.

Children also often develop spontaneous and situation-specific explanations; for example, that the liquid might come from the fridge, because the fridge is broken. Children can then put the bottle inside a different fridge and observe it. Here, one should note that even contradictory evidence does not immediately lead to a change in ideas. As a rule, several encounters with similar phenomena or conflicting observations are needed for ideas to develop further.

Encouraging comparisons

Another particular feature of scientific learning is that phenomena can be discovered in settings that, on the surface, appear very different – and it is especially difficult for children, who usually have little prior knowledge, to recognise the correlation between these settings. For this reason, when supporting learning processes, it is important to encourage comparisons, by asking questions such as: "Have you already seen this before?" "What is similar here?" "What is different?" Comparing helps learners to discover common underlying concepts (cf. Rittle-Johnson & Star 2009). For example, children do not necessarily connect different dissolution processes, such as salt dissolving in water when cooking pasta, sugar dissolving in tea or the fact that sand does not dissolve in water, because the situations differ from one another in various ways. By stimulating comparisons, phenomena that initially appear to be very different from one another can be connected together, in order to develop more generalised and practically applicable early knowledge.

Discovering ways of thinking and working in many different settings

This approach also effectively supports understanding of ways of thinking and working. If children discover, for example, that things can be compared and ordered in many different settings (when tidying building blocks and Lego bricks, when emptying the dishwasher, etc.), this can help them to rediscover the same phenomenon or approach in a new setting, and therefore to increasingly generalise their experiences. Within primary education, similar methods are referred to as "phenomenon circles" (Spreckelsen 1997). Learners experience and investigate a specific phenomenon in different contexts.

Interrelated activities and required prior knowledge

It therefore makes sense to organise interrelated activities; children can engage with a question or topic for a longer amount of time and also develop experiences, key vocabulary and basic knowledge in different contexts. Moreover, it is important to consider which prior knowledge and vocabulary children need to have before exploring a certain topic. For example, to give them the chance to develop an early understanding of magnetic attraction, they must first be familiar with basic materials such as wood, plastic and metal.

Indicators for cognitive support

The quality of cognitive support cannot be assessed based on a single setting, but rather using a number of different indicators.

Indicators for cognitive support include:

- *Choice or use of activities which:*
  - *have the potential to make children think*
  - *allow children to explore things at their own pace and develop their own ideas*
  - *take children's interests into account*
  - *enable children to learn in different kinds of ways*
  - *represent subjectively meaningful learning opportunities, and*
  - *relate to core ideas.*
  - *(Repeated) use of relevant vocabulary and verbal structures*
- *Stimulation of observation and awareness of a phenomenon with several senses, where appropriate*
- *Asking about children's perceptions and ways of thinking*
- *Asking for explanations*
- *Encouraging interpretation and discussion of prior experiences, observations and data*
- *Creating links between observations and pointing out differences and similarities*
- *Pointing out contradictions between ideas, observations and assumptions*
- *Encouraging the creation of links and early generalisations*
- *Emphasising and summarising important observations and ideas, i.e, those which lead to further development*

Experiments do not necessarily stimulate thinking

Scientific education is often seen as closely connected to carrying out experiments. But simply carrying out experiments is no guarantee of cognitive activity. Experiments can only be seen as stimulating interactions if they provoke thought and are embedded within a learning environment where, for example, the underlying question, the approach, observations etc. are discussed. It is also not always clear what children are meant to be discovering or learning from an experiment. Thus there are often activities such as making a volcano out of baking powder and vinegar, which is certainly fun for the children, but where the scientific content remains unclear (unless the central theme is about carbon dioxide gas – a topic which is, however, very challenging). Such activities can give children the impression that science is something that may be fun, but seems largely like magic and therefore cannot be understood. Therefore, activities of this kind are limited in terms of their suitability for stimulating children towards active cognitive engagement. With regard to scientific knowledge, it is also important to consider the ways of thinking and working which are used. For example, in order to develop an early understanding of observations, it is usually not sufficient for children to observe something – thinking about the process together as a group is critical.

The steps of scientific knowledge acquisition are often used in order to structure scientific learning processes, reflect on knowledge acquisition and stimulate an understanding of science.

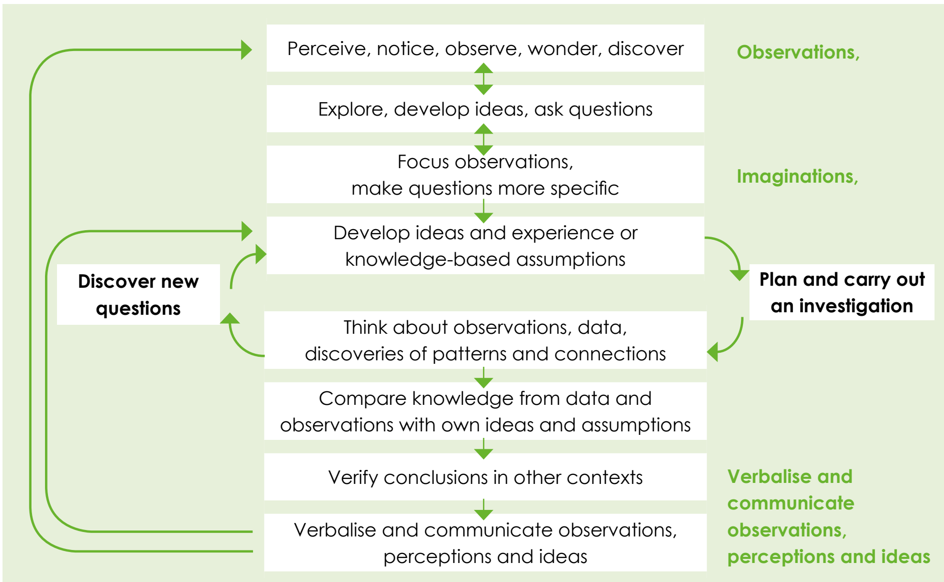

Figure 3: Phases of scientific knowledge acquisition in young children (Steffensky 2017)

This process should not be seen as a rigid one, and the arrows in Figure 3 certainly do not show all possible routes for children. Younger children will often not follow the path to the end, but are more likely to explore in a holistic way, generating ideas from which new observations and ideas then develop. Towards the end of the preschool period, children begin to proceed in a more strongly systematic way. However, consideration for the various phases, and the stimulation of thought in the individual phases and across the different steps, reflect important aspects of cognitive support such as comparing, making connections and formulating one's own ideas.

Encounters with scientific phenomena or approaches can take place in very different educational settings, such as projects, during play or even in routine situations, e.g., at communal mealtimes; and in different places such as the forest, garden, workroom or research area. In terms of scientific learning processes, the critical factor is not the choice of the place or the setting, but the quality of the interactions.

3. Conclusion

Scientific education, alongside other educational fields, constitutes an important entry point to the world and to culture. It helps us to understand the animate and inanimate nature that surrounds us. Children's everyday environments present a range of settings where striking but also unspectacular phenomena can be observed. Many children are naturally interested in these phenomena or develop an interest in them, if they are made aware of a phenomenon or encouraged to think about it.

The role of the education professional

As in other fields of education, managing and supporting scientific learning processes for children with diverse requirements is challenging and demands an active role for early education professionals. It is their role to observe and analyse how children recognise and make sense of perceptions, but also to actively intervene by using leading questions or stimuli. Particularly for children with little prior experience, it is often not sufficient to provide a stimulating environment – targeted support from an early childhood education professional is needed in order to stimulate learning processes. It is often assumed that an active role for the education professional means a passive role for the child. This view is increasingly being revised within the world of education. Teaching and learning processes can hardly be separated from one another and the terms instruction and construction should not simply be seen as opposites, but rather as closely connected (cf. Tournier 2016; König 2009). High-quality learning opportunities that encourage children to think – in everyday situations or more formal educational settings – are fundamental in helping children get to know, value and feel connected to the animate and inanimate world around them, and at the same time build strong foundations for their scientific education in primary school.

4. Questions and further information

4.1 Questions and tasks for reviewing the text

TASK 1:

In one centre, a weekly experiment is carried out every Friday. Last week, a pond skater was observed through a magnifying glass; this week is about air pressure, and a boiled, peeled egg is inserted into a bottle; while next week a sherbet rocket will be built. What is your assessment of this approach to implementing scientific education?

TASK 2:

Imagine that you are baking a cake in the kitchen of the childcare centre with a group of children. Which scientific factors could play a role in the discussion or activity in this setting?

TASK 3:

Children's understanding of the world around them is closely linked to their ability to express ideas verbally. How could you encourage children to use language creatively, in order to foster their scientific curiosity and engagement in a playful way?

QUESTION 1:

Thinking about the last few days, what basic scientific observations and experiences, such as the misted-up mirror during a shower, have you encountered (possibly unconsciously)?

4.2 References and recommended reading

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RECOMMENDED READING

Fleer, M. (2017): Scientific Playworlds: a Model of Teaching Science in Play-Based Settings. Research in Science Education. doi:10.1007/s11165-017-9653-z

Fleer, M. (2019): Turning preschool into a pipeline for female engineers. Available at: https://lens.monash.edu/@education/2019/03/20/1373688/developing-preschool-pipeline-for-female-engineers. Accessed on: 21.06.2019.

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4.3 Glossary

Science There is no clear definition of science. Instead, one often finds lists of characteristic features. The focus of science is to describe and explain animate and inanimate nature. Current research, however, tends to focus on the application of science, e.g., in order to develop new drugs or chemical weapons.

Scientific knowledge consists of two central areas: first, knowledge of vocabulary, phenomena, concepts, theories and laws, and second, knowledge of the source and the quality of this knowledge.

Cognitive support is described as a component of process quality, and is used to encourage children to think. Cognitive support cannot be directly evaluated from a single situation, but must be assessed using various indicators.

Fleer, M. (2017). Scientific Playworlds: a Model of Teaching Science in Play-Based Settings. Research in Science Education. doi:10.1007/s11165-017-9653-z

The series KiTa Fachtexte is a collaboration between Alice Salomon University, the FRÖBEL Group and the professional development initiative for early childhood practitioners Weiterbildungsinitiative Frühpädagogische Fachkräfte (WiFF). The series aims to support teaching staff and students at universities and practitioners in crèches and childcare centres by presenting the latest articles for study and practice. All the articles in the series are available online at: www.kita-fachtexte.de

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