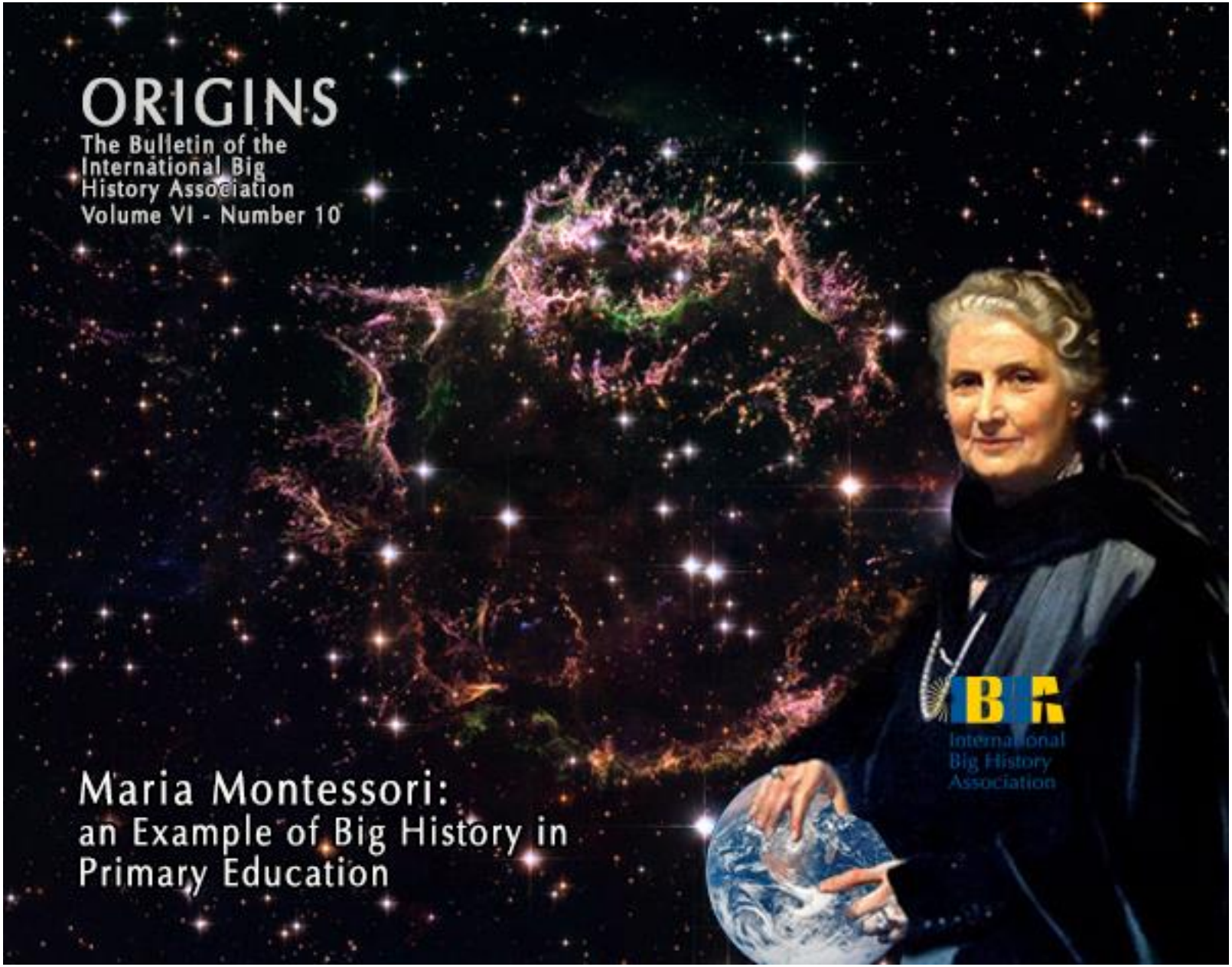
ORIGINS
The Bulletin of the International Big History Association
Volume VI - Number 10
Maria Montessori:
an Example of Big History in Primary Education
IBHA
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Maria Montessori: an Example of Big History in Primary Education

In this issue of *Origins*, we highlight the experience of teaching "Cosmic Education" within Montessori schools in the Netherlands.

This group of Montessori teachers and trainers address the question: how can we bring the child between 0-12 years to experience space and time? During their study, they developed a framework for Big History and cosmic education based on the lines of life (Werkhoven, 1997) and formulated several sub-questions about a cosmic approach. In this special issue of Origins, we present the results of their work. The group has become a Dutch Montessori platform for cosmic education; they will continue their study in the coming years.

In 1907, Maria Montessori opened the Casa dei Bambini, or Children's House, in a low-income district of Rome. Her unique philosophy sparked the interest of educators worldwide, and in the following decades Montessori schools opened throughout Europe, in North and South America, and, finally, on every continent but Antarctica. Dr. Montessori first described her approach in *Il Metodo della Pedagogia Scientifica applicato all'educazione infantile nelle Case dei Bambini*, published in 1909. The book's English-language version, succinctly titled *The Montessori Method*, was influential on both sides of the Atlantic.

Dr. Montessori recognized that all of science and history tell portions of the same story: the continuing creation of the universe. "Cosmic Education" tells that story. In a uniquely Montessori way, the experience offers children context for, and reveals connections between, such subjects as astronomy, chemistry, geography, history, and biology, to name a few. "Learning" the academic subject matter, however, is secondary to a loftier educational goal.

In their book, *Children of the Universe*, Montessorians Michael and D'Neil Duffy sum up the purpose of Cosmic Education neatly: "This six-year Montessori experience gives elementary students opportunities to appreciate their roots in the universe, to sense their place in its context, and to embrace the role this defines for their lives."

"Cosmic Education is intended to help each of us search for our cosmic task as a species and as individuals. To do this, we must understand ourselves in context. It is only against the background of our place in the universe, our relationships with other living organisms, and our understanding of human unity within cultural diversity, that we can attempt to answer the question, 'Who am I?'" (Michael & D'Neil Duffy, *Children of the Universe: Cosmic Education in the Montessori Elementary Classroom*.)

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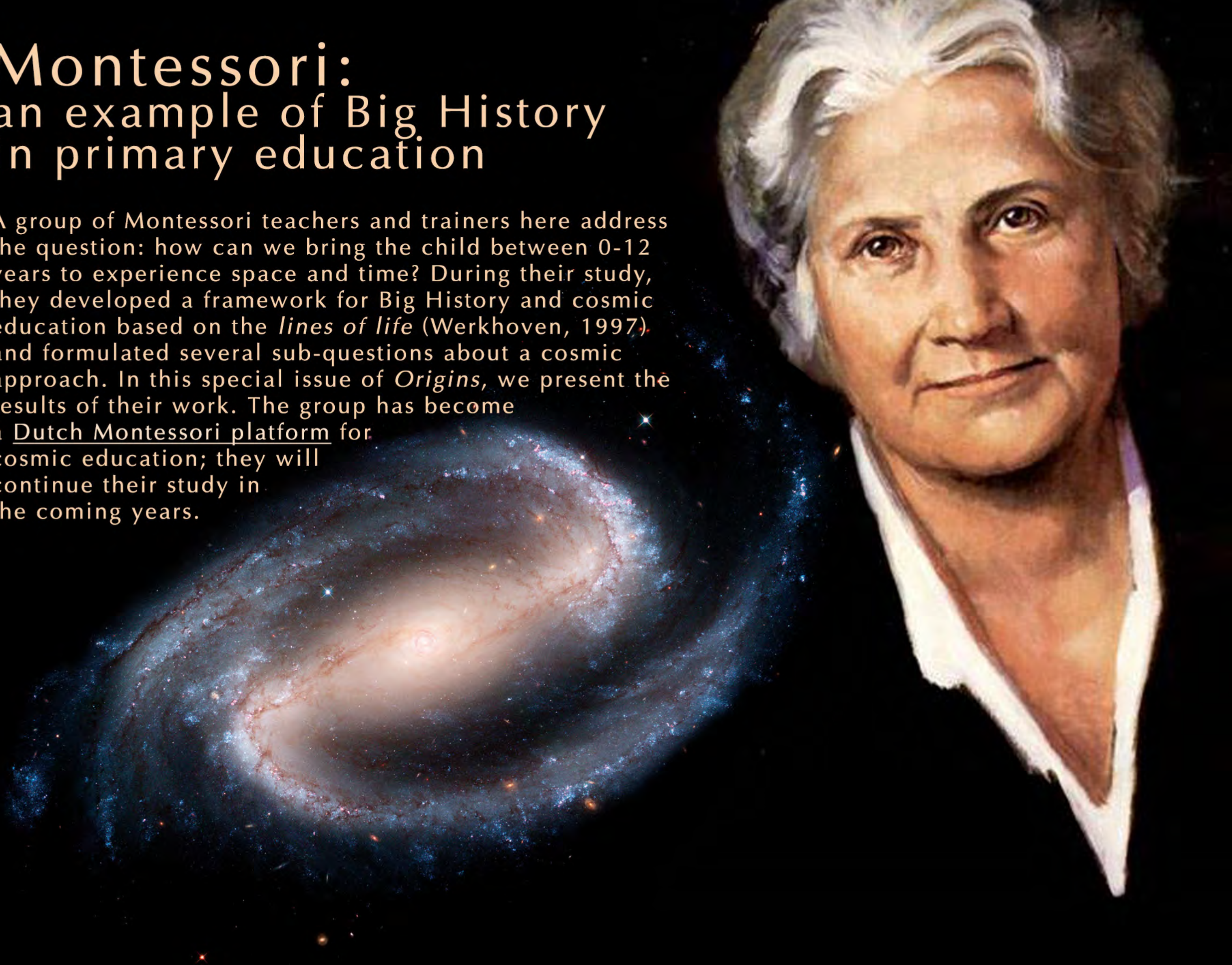
Montessori:
an example of Big History in primary education

A group of Montessori teachers and trainers here address the question: how can we bring the child between 0-12 years to experience space and time? During their study, they developed a framework for Big History and cosmic education based on the *lines of life* (Werkhoven, 1997) and formulated several sub-questions about a cosmic approach. In this special issue of *Origins*, we present the results of their work. The group has become a Dutch Montessori platform for cosmic education; they will continue their study in the coming years.



A Framework for Big History and Cosmic Education:

An overview of space and time and a cosmic approach to development

by Anne-Marie Poorthuis

Introduction

Motivated by the question how we teach Big History in primary education and what we learn from Montessori Cosmic Education as an example, last year we started talking and training with a group of trainers and teachers in the Montessori Education. Two ambitions for Montessori Cosmic Education emerged, being the ambition to arrange the totality of space and time into a coherent overview and the ambition to form a cross curricular cosmic approach to development. In this paper we describe a framework that we have designed to get an overview. It was a pleasant surprise when it turned out that we can also use the framework for a cosmic approach to development. The framework is not specific to primary education. In essence every person can use this multidimensional framework. Schools and teachers can use the framework to prepare their education and to see development in coherence. Big History can use the framework to build on research and teaching. Specifically, we look how we can make the framework accessible for teachers and children in primary education. Finally, we describe some tools to give further shape to a cosmic approach to development.

Framework Big History and Cosmic Education

Point of departure	(Story)line	Formula for development			Perspective
Space	Time	Subject			Object
Universe	Major events	Observe: Ingredients	+	Goldilocks conditions = New complexity	The big picture
Humanity	Fundamental issues	Research: Collect	+	Differ = Divide and share	Collective consiousness
Culture	Patterns and structures	Build: Materials	+	Prepared environment = Education	Common ability
Self	Talents and relationships	Learn: Discover	+	Explore = Understand	Own example

A Framework for Big History and Cosmic Education, Poorthuis 2016

The construction of the framework

The framework consists of four points of departure, four story lines, four formulas and four perspectives.

The points of departure stand for space, the storylines for time, the formulas for subject and the perspectives for object. In essence, the framework brings together four elements: space, time, subject and object.

- The four points of departure are inspired by "the lines of life" of Jos Werkhoven (1997) and provide four levels of space: self, culture, humanity and universe.
- Following the points of departure we distinguish four storylines with moments that mark the time: the storyline of the major events of the universe, the storyline of the fundamental questions of humanity, the storyline of the patterns and structures of the culture and the storyline of the talents and relationships of ourselves.
- An interesting parallel between the formula of Big History: ingredients + Goldilocks (favorable) conditions = new complexity and the formula of Maria Montessori: materials + prepared environment = education has led to the search of logical formulas in each of the four levels of the framework. Through the subject the four formulas integrate in a cosmic approach to development.
- The four perspectives give invitation and challenge to development. The perspectives show what objects of attention are: the big picture, the collective consciousness, the common ability and the own example. It is both a historical, present and future perspective.

Universe as point of departure

From the universe as a point of departure, time is marked by major events started by the Big Bang to present. A few of these major events are the formation of stars, atoms and molecules, earth and solar systems, life and humanity. David Christian, founder of Big History (https://bighistoryproject.com) mentions these major events, that mark the development of space and time, thresholds and suggests that the formula by which we observe development is the same for all thresholds: ingredients + goldilocks conditions = new complexity. Complexity grows with each subsequent threshold. Each threshold is like a jump. Perspective is the big picture.

It is impressive that the major part of the time on this line is before the origin of humanity. When we follow the theory of growing complexity, we can say a human being is so far the most complex creation that ever has arisen. An important feature of this complexity of humanity is collective learning. Human beings exchange ideas, put them together and create new ideas. Humanity has a collective consciousness. Nobody knows everything, but a rich language makes possible to transmit information and to combine knowledge.

The latter thresholds of Big History follow the development of humanity. But

Point of departure	(Story)line	Formula for development			Perspective
Universe	Major events	Observe: Ingredients	+	Goldilocks conditions = New complexity	The big picture

the origin and development of humanity is only a major event on the line of the universe. An interesting question is what will occur after humanity. What do we perceive? What ingredients could come together under goldilocks conditions and give a new and growing complexity? We cannot imagine but we can observe movements. For example, what happens if different galaxies come together, the universe expands further or the sun disappears? What new complexity appears? These movements also depend on the goldilocks conditions of the moment.

Humanity as a point of departure

From humanity as a point of departure, time is marked by fundamental issues. The formula that emerges from the history of humanity is the same for all the issues: collect + differ = divide/share. The complexity of the issues grows and humans develop in the use of the formula.

In the first period of human development, the focus is on collecting (food), in the second period of human development on differ (exemption and specialization of people), and in the third period of human development on divide or share (competition and cooperation). The perspective of humanity is collective consciousness.

After fire control, the ongoing search for food is an important issue for human as hunter/gatherer. The emergence of agriculture begins with cultivating the land and tame animals. Probably, issues of overpopulation and climate change have stimulated the transition to agriculture. By agriculture, there is more and more the exemption and specialization of people and with the emergence of towns, cities and states the trade comes. In the modern world the issues are more complex. In particular, technological developments are not to keep. Through increased awareness, we are more aware of our impact on the big picture, without being able to foresee the consequences. This brings the question of responsibility for these human influence more and more forward. An issue that is so complex that we need more and more a collective consciousness. What do we give to the next generation?

Point of departure	(Story)line	Formula for development					Perspective
Humanity	Fundamental issues	Research					Collective consiousness
		Collect	+	Differ	=	Divide and share	

Culture as a point of departure

Point of departure	(Story)line	Formula for development					Perspective
Culture	Patterns and structures	Build					Common ability
		Materials	+	Prepared environment	=	Education	

From the culture, time is marked by patterns of living structures. Perspective is the common ability. Inspired by Maria Montessori, we use a formula for cultural development: materials + prepared environment = education. In the Montessori Education the prepared environment is an understanding (Montessori, 1949). By preparing the environment we create the best possible conditions for (self) education, including the selection and access to materials. Training can be prepared but not controlled. What appears is always a surprise.

During the time of the great empires, the expansion and exchange of agricultural societies, the pattern is made especially by the all rulers, the monarchs. When the great empires disintegrated, the monarchs lost their power and smaller states emerged. The economic and commercial influences grow and the pattern is more and more shaped by markets and trade. Technological development makes people more easily come into contact with each other and form more global networks. Developments are going faster and faster, but the issues are becoming more complex and require more ability. Fred Spier (2010), one of the Big Historians from the beginning, describes that humans can determine to a certain extent, their own ecological and social Goldilocks circumstances by using unprecedented amounts of matter and energy. However, the question is what will happen in the near future both to humanity and to Earth? This uncertainty about the future of humanity and Earth, is seen more and more in global meetings between powers and initiatives at the global level to address these fundamental issues of humanity. Do we need a global community to face the future?

Self as a point of departure

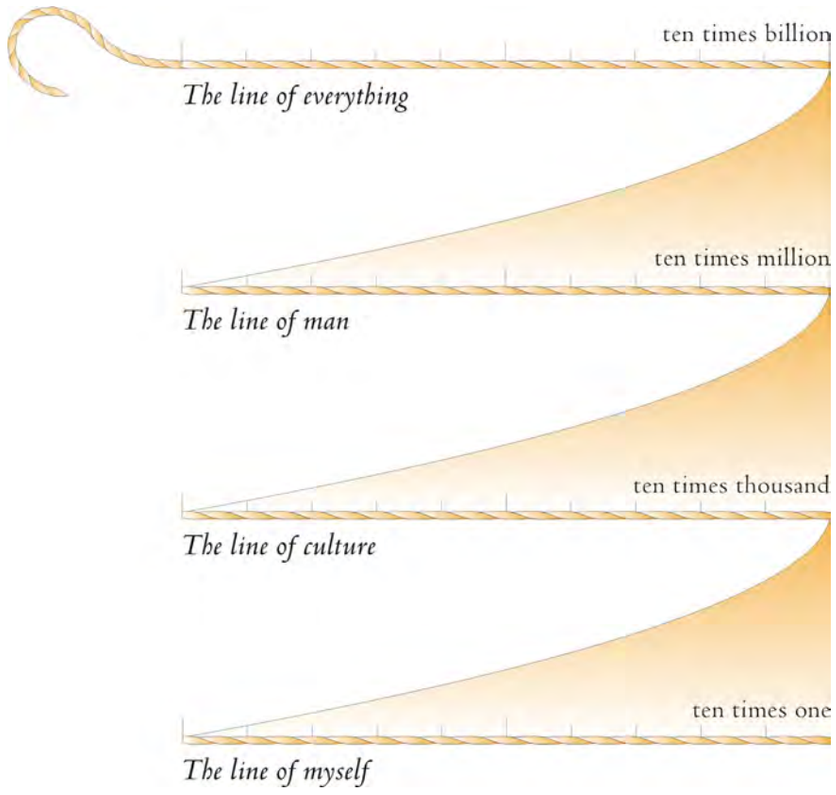
Point of departure	(Story)line	Formula for development				Perspective
		Learn				
Self	Talents and relationships	Discover	+	Explore	= Understand	Own example

From ourselves, time is marked by the development from birth till now. In general, we distinguish child, adult and elderly and inside different stages in which we discover, explore and understand our talents and relationships. In Montessori education we distinguish the periods of 0-6 years, 6-9 years, 9-12 years and 12-18 years. Maria Montessori (1940) sees each child as a unique contribution to the world. When we follow the child's development than we come "through the child to a new world."
In the development of our talents and relationships we can also talk about a growing complexity. Inspired by Maria Montessori, we use the formula: discover + explore = understand.

Maria Montessori describes the child under 6 years as a discoverer, the child of 6-9 as an explorer and the child of 9-12 years as a 'scientist'. These are the periods during which the child in terms of development is able to apply that part of the formula. A formula we can apply not only in education, but in our whole lives. The challenge of a lifelong learning and being an example. The challenge which let grow talents and relationships to full fruition and leverage. Perspective is the own example. Maria Montessori describes the development of this perspective as: help me to do it yourself.

Opening up the framework for children

The four points of departure of the framework are inspired by the lines of life (Jos Werkhoven, 1997). A mathematical surprise, that we can use with the introduction of the frame to children, shows that each line is about one-thousandth of the previous line and arises from the last fraction of this previous line. The line of everything is about 13.8 billion years. The line of man is approximately 10 million years. The line of culture is about 10,000 years and the line of myself in primary school is about 10 years. If we place ourselves on these four lines, we come to realize that human beings in general and ourselves in particular, only be a very small part of the total time.

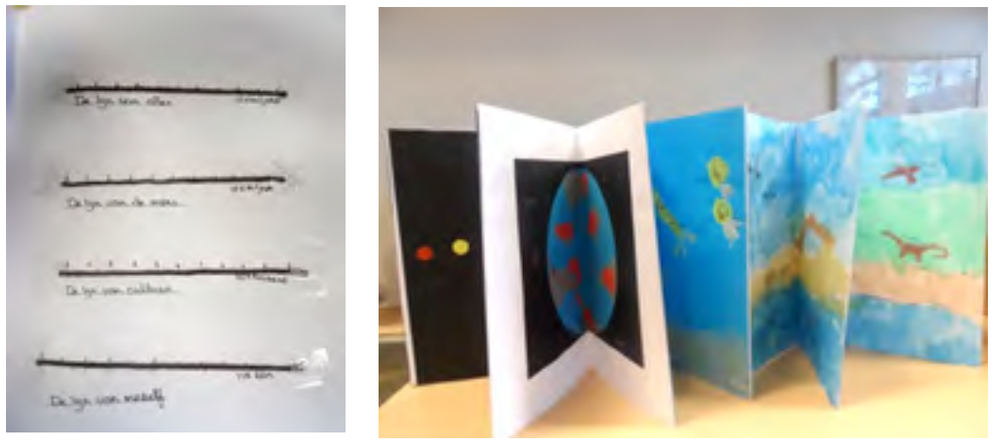


Lines of life, Jos Werkhoven (1997, 2011)

Teachers and children can visualize the timelines for example with ropes and ribbons through the school, the classroom, the garden or the city. Children can begin with the individual lines and mark the different developments. Marks on a timeline give guidance. When children make their own example and not blindly follow a curriculum, they gain more awareness of the framework itself and can apply it easily in different situations.

Children can experience the time by stories. Teachers can tell the story of space and time frequently during the year or throughout the school time and can invite children to create their own story. For background information see "Once upon a time, there was a story to be told"(Werkhoven, 2011).

Perspectives on a cosmic approach to development
Following the four points of departure, the framework shows four perspectives on development. It is special that we can put these perspectives on the past, present and future. We can motivate the perspectives in history and suggest that these



Work of children from the first Montessorischool in The Hague (2016)

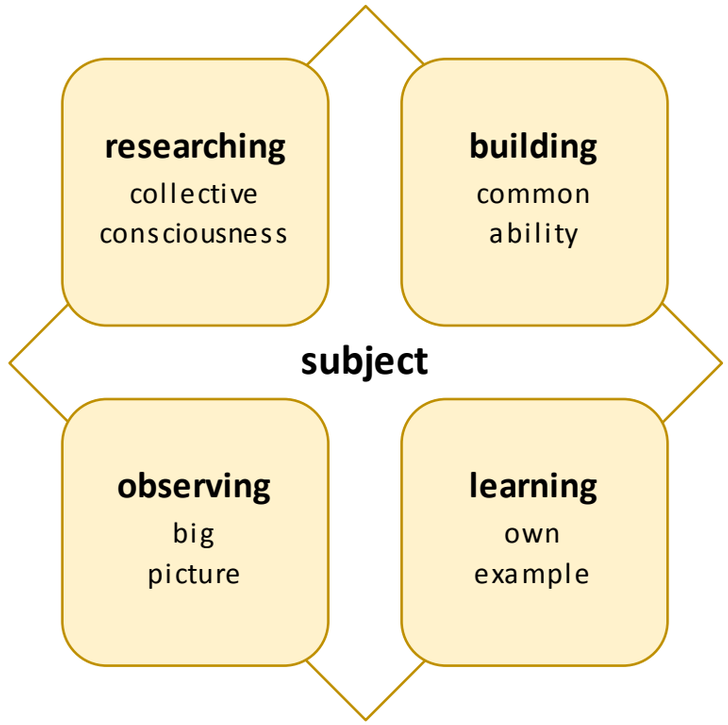
perspectives are still a challenge for the future.

Our history shows that we humans are part of the big picture, the collective consciousness, the common ability and the own example and shows that our involvement will affect development. The question is whether we care and want to take responsibility for the impact we have on development. We cannot determine the future. We can invest in the best possible conditions for a cosmic approach to development without losing the four perspectives from the eye. This brings us to the ambition we set for Montessori Education: cross curricular shaping a cosmic approach to development. Essentially comprises a cosmic approach to development:

- observing the big picture
- researching the collective consciousness
- building the common ability
- learning the own example

Everyone involved, whether school, team, teacher, student, parents and others can give identity to a cosmic approach for development. This identity can be given by integrating observing, researching, building and learning around a chosen topic.

We bring this into view using four quadrants. These four quadrants may work by itself, successively, in interaction, and as a whole. A cosmic approach to development ask from people involved that they can maintain and organize this dynamic of relationships.



Cosmic Quadrants Model, Poorthuis 2016

Formulas for a cosmic approach of development

In the framework we distinguish next four points of departure, storylines and perspectives, four formulas. People involved (observers, researchers, builders and learners) can approach with these formulas the development in space and time. An interesting parallel between the formula of Big History to (current and future) thresholds of increasing complexity: ingredients + goldilocks conditions = new complexity (David Christian, http://bighistoryproject.nl) and the formula of Maria Montessori (1940): materials + prepared environment = education inspired the search of logical formulas for approaching development at each of the four levels of the framework.

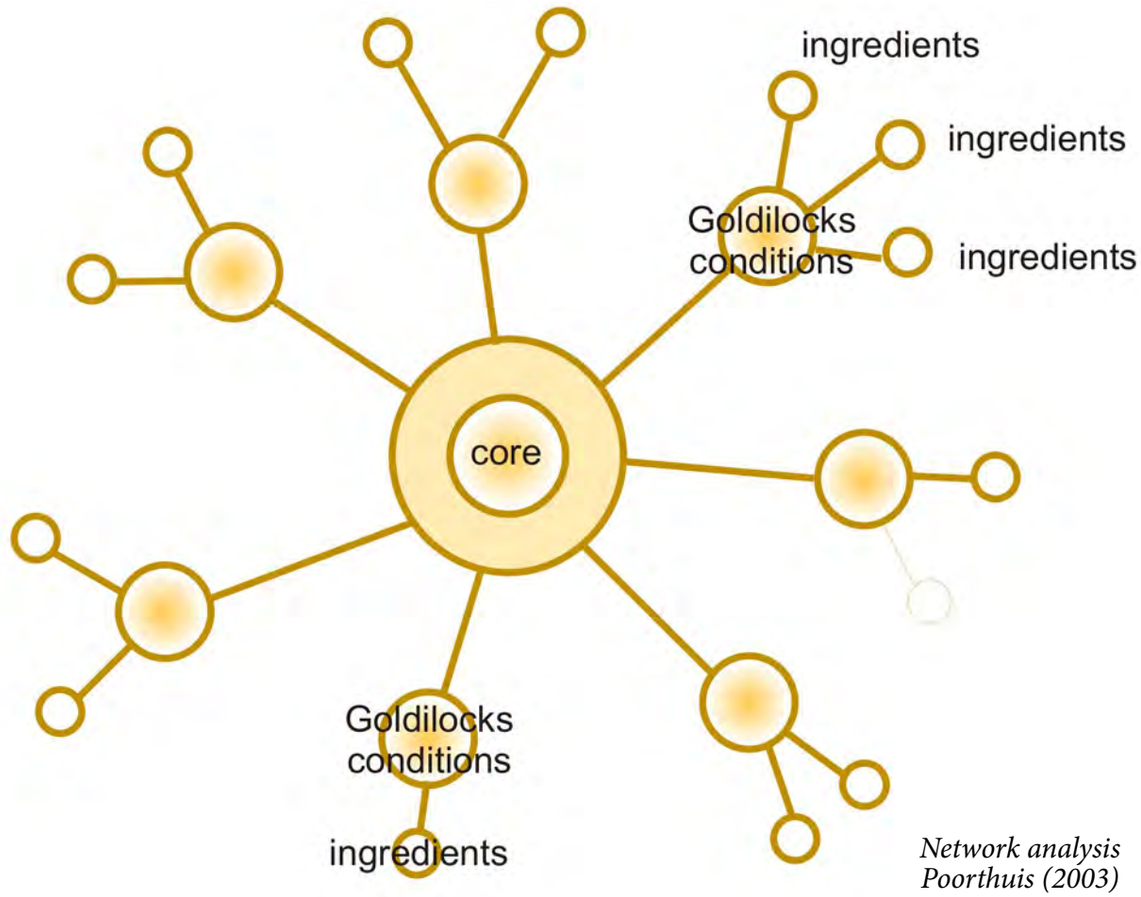
- Formula 1: ingredients + goldilocks conditions = new complexity
  The development of universe is marked by major events. Using the formula, we can observe the events and place them in the perspective of the big picture.
- Formula 2: Collect + differ = divide / share
  The development of humanity is marked by the fundamental issues. Using the formula, we can research the issues and place them in the perspective of

the collective consciousness.

- Formula 3: materials + prepared environment = education
  The development of culture is marked by patterns and structures. Using the formula, we can build the patterns and structures and place them in the perspective of the common ability.
- Formula 4: discover + explore = understand
  The development of self is marked by talents and relationships. Using the formula we can learn talents and relationships and place them in the perspective of the example.

Network analysis

A tool for working with the formulas is the network analysis by Poorthuis (2003). Coincidentally the steps of the network analysis fit perfectly with the formulas. The network analysis of Poorthuis is used for ordering involvement and building network structures as a basis for development. Applications of these network analysis can be found in the research program of the WUR: Networks in animal husbandry (Wielinga 2008) and the research program of the Open University: Organizing a network learning school (Poorthuis, 2011). We incorporated the formula of Big History: ingredients + goldilocks conditions = new complexity in the steps of the network analysis.



Network analysis Poorthuis (2003)

Steps of network analysis integrated with the formula of Big History

1. Take a large sheet of paper and place the (historical, present or future) event as a core in the middle. We can make this network analysis individually or in groups. Anyone can join, such as teachers and children through the school or parents. Instead a large sheet of paper, we can work on paper tablecloths.
2. Then collect all the ingredients involved in this event and write these ingredients around the outer edge of the paper.
3. Go in search of goldilocks conditions (people, resources, situations) which make the ingredients are connected with the core and place these conditions on the paper between the ingredients and the core.
4. Now a dynamic network structure appears. Ingredients and goldilocks conditions integrate in complexity.
5. The more the core remains connected to (new) ingredients and conditions, how more dynamic the network.
6. If necessary (if we get stuck in complexity) we go back to the core and start again to analyze and build the network.

Finally

As described, the framework provides an overview of space and time and a cosmic approach to development. The framework does not give so particularly the content, but shows a cohesive tissue. Challenge is to discover the variety of possible relationships. We invite researchers and teachers to test the framework for the next Big History Conference.

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Wielinga et al. 2008. *Networks with free actors, Encouraging sustainable innovations in animal husbandry by using the FAN approach*. Research program Wageningen UR. (page 57 the Network Analysis). Anne-Marie Poorthuis is designer and researcher in networked organizing and director of a foundation for network development around current social themes and issues of organizing. She lives and works together with Jos Werkhoven and has been inspired by Big History over 20 years. She facilitates the platform and leads the research into cosmic education and Big History primary education.

Maria Montessori in 1913

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Montessori,
a cosmic approach of education

by Jos Werkhoven

Introduction

Cosmic thinking became a principal idea in the Montessori movement with the publication of 'To educate the human potentential' (Montessori, 1947). "Working in the spirit of Maria Montessori" made a start with the development of a course on cosmic education by Mario Montessori in the years after the death of Maria Montessori.

In my own teaching practice, I first considered cosmic education as a 'curriculum' in addition to the curricula of language, math, visual arts, music, physical education, etc. Only later did I see it as a way of thinking and working.

In this article, I want to show that cosmic education is not only a 'curriculum' and Big History is not just a scientific discipline, but that cosmic education is a way of observing, researching, building, and learning. It is a study tour for people[1] to learn and to live in obvious relation with the totality of space and time. This is quite apart from the moral and ethical values which also call for harmony with all living beings and the need to worry about the water and food supply for the world, concerns about climate change, ensuring a virtually uncontrollable and disproportionately distributed economy.

It will be clear that learning and living in relation to the totality did not begin only after the publication of Montessori in 1947. Rather, it began in 1907 when an association for home improvements in a Roman slum invited Maria Montessori to take the lead in a 'Casa dei bambini', an orphanage where children were housed while their parents worked. The experiences in the children's homes with children between three and six years old were Montessori's main inspiration for writing 'Il Metodo della Pedagogia Scientifica applicato all'educazione infantile nelle Case dei Bambini, first edition in 1909'. Examples and statements we follow in that first work[2] which are confirmed in the later publication of Montessori in 1947.

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1 The study tour to humans is the same as the child's pathway.

2 Use has been made of the eighth Dutch edition, 'De methode, de ontdekking van het kind, Maria Montessori' Van Holkema & Warendorff N.V. 1966

Classification
First you read about the interpretation of cosmic thinking and working; learning and living in relation to the totality. Second the cosmic thinking and working of Maria Montessori are illustrated by statements and vision of nature, a scientific approach to education, freedom, prepared environment, the observant teacher in the living school and Montessori materials.

Learning and living in relation to the whole; cosmic thinking and working.
The concepts of 'learning and living in relation to the whole; cosmic thinking and working' are filled with:

1. In my view, the best quote of Maria Montessori of cosmic education, described in 'To educate the human potentential:"[3]

"Let us give the child a vision of the entire universe. The universe is an impressive reality and the answer on all questions. We will collectively walk this path of life, for all things are part of the universe, all with each other connected in a comprehensive unity. This image helps the child's mind to focus, to stop wandering in an aimless quest for knowledge. it is fulfilled, it has found the universal center of himself and all things.
it is imperative to focus the interest of the child to a midpoint. the methods which today are common, however, are not effective. How to keep the spirit of a growing individual interest as all our education deals with a specific topic with a limited scope and limited to the transfer of knowledge those little details that he is able to memorize? How can we force the child to be interested as interest can only come from within? Only duty and fatigue can be brought about from outside, never interest! Let me be very clear. "

2. The words which I myself have tried to describe compact cosmic education:
"Montessori education = cosmic education is relational education. Montessori education = cosmic education is a starting point of education in which the child learns as a researcher to establish relationships within the totality of time and space in relation to the present and a possible future."

3. The words which the Big History Association states the purpose of Big History:
"Big History seeks to understand the integrated history of the Cosmos, Earth, Life, and Humanity, using the best available empirical evidence and scholarly methods."

4. The framework Big History and Cosmic education[4] (Poorthuis, 2016).
This framework can provide insight into relationships in development by asking questions on four levels (ourselves, culture, humanity, universe; the totality of space and time), using the storyline and the formula.

Note to 1.
Maria Montessori writes: *". . . all things are part of the universe, all with each other connected in a comprehensive unity. "*
'All things are part of ' and 'connected in a comprehensive unity' I understand that all in one way or another has a relationship with each other and in unity.
' . . . to stop wandering in an aimless quest for knowledge . . . ' = '. . . a limited scope and limited to the transfer of knowledge those little details that he is able to memorize . . . ' but the child may perform free research on possible relationships =' *. . .helps the child's mind to focus . . . '*

3 Dutch edition: 'Onderwijs en het menselijk potentieel, 1998', Dutch Montessori Association, p 14

4 Framework Big History and Cosmic Education, Poorthuis 2016

Framework Big History and Cosmic Education

Point of departure	(Story)line	Formula for development			Perspective
Space	**Time**	**Subject**			**Object**
Universe	Major events	Observe Ingredients + Goldilocks conditions = New complexity			The big picture
Humanity	Fundamental issues	Research Collect + Differ = Divide and share			Collective consiousness
Culture	Patterns and structures	Build Materials + Prepared environment = Education			Common ability
Self	Talents and relationships	Learn Discover + Explore = Understand			Own example

Anne-Marie Poorthuis, 2016

Note to 2.
It isn't a coincidence I give the term 'relation' a prominent place in my own definition of the terms.
Personally, I see the relation as the most important aspect of cosmic education and Big History and a challenge for the future: we learn to give shape to the concept of humanity in relation to all there is, using the relationships we found and understand.

Note to 3.
If I understand well *'seeks to understand the integrated history'*, then I can read *'integrated history'* as 'relational linked history' which one tries to understand. Big History is always looking for the not always easily visible relationships that are at every level in time and space. '*To understand'* is a desire to learn and to understand as human to have a better relationship with the world around us.

Note to 4.
The framework shows utilizing talents and relationships as a development line of ourselves.[5]
In summary, I dare to say that getting to know and recognize relationships in the overall space and time on every conceivable level is a very important core of cosmic education and Big History.
The organization of our mainstream education system dates from a time (19th century) when life was less complex. The organization of former society demanded the transmission of certain knowledge. The rapid changes of our time asks us to learn and to live in relationship with the complex totality that presents itself to us. Unfortunately, in education we have focussing too long merely on transferring knowledge. The transfer of knowledge will always remain an important pillar of education, but it should not just become limiting and reproduce (= institutionalize) as Maria Montessori describes: "*How to keep the spirit of a growing individual interest as all our education deals with a specific topic with a limited scope and limited to the transfer of knowledge those little details that he is able to memorize*? "Besides the transfer of knowledge, the teaching and the organization of our life needs other incentives and vision to have aroused interests.
Maria Montessori understood the essence of cosmic education and not just since 1947. The most important part of her life and work was observation. To identify with the working formula[6] of Big History: ingredients + favorable conditions = new complexity. Maria Montessori observed the

5 See framework.
6 See framework.

What child would for example like to start a puzzle which has no overview image and the child strongly strongly suspects that is missing a lot of pieces?

So is also our regular education: we know in advance that we can never know everything, the big picture is missing. Cosmic education and Big History are able to offer that picture.

ingredients, they saw the relations which created (un)favorable conditions and chose the best to get new complexity which was most of the time surprising.

In the remainder of this article I will give some examples of vision statements from Maria Montessori's first work 'Il Metodo della Pedagogia Scientifica applicato all'educazione infantile nelle Case dei Bambini, 1909', which in my opinion illustrates its relational cosmic thinking.

The cosmic thinking and work of Maria Montessori

In 1909. Maria Montessori published 'The method'. In this book she writes in a cosmic way about the Case dei Bambini: *"For the 'Case dei bambini' does not just represent a social progress, but progress of humanity . . . "*(P. 71.)

CASA DEI BAMBINI - Rome, San Lorenzo
Opening Januari 6, 1907.

The progress which Maria Montessori speaks, is not limited only to education that, as you will read later, cosmic formed, but it concerned all the relationships in the area of the school which made life for everyone more pleasant:

as a doctor she could give good advice on how to improve the hygiene: presence of hot and cold water for the children and washrooms in the houses;

- besides to the school garden, where vegetables were grown for common use, there were 'common' plants in the corridors of the houses and squares which were placed jointly and maintained jointly; in addition to the fun and beauty of it, it strengthened the responsibility of the community;
- there was explicitly asked for parental cooperation to continue the education of school at home*: "We have placed the school in the house as the property of the community.";*
- emancipation and liberation of women; by the care of the children there was more space for the women.

The book shows the multilayer[7] cosmic thinking of Maria Montessori: not just the self-interest (line ourselves) or interest on own cultural choice (line of culture), but a choice for humanity as a whole (line humanity).

The nature

Montessori's multilayer cosmic thinking is completed with the following quote[8] : *"The man of science is not the wielder of instruments - but the knower of nature."*

". . . the knower of ***nature***." ***Nature***, which is shaped according to the multilayer cosmic thinking in 'The Line of everything (universe).'
Maria Montessori states in her book to examine the concept of ***'nature'*** and describes the importance, for both teacher and child, ***'nature'*** good to observe.
Montessori doesn't extensively describes the concept of ***'nature'***, but in any quote you taste the 'cosmic thinking' which Maria Montessori, probably under the influence of Jean-Jacques Rousseau (1712-1778), ascribes to nature and what with a scientific approach - depth observation and research - can be better known.
In another publication[9] Maria Montessori says the following about ***'nature'***:
"What shows us humanity in its development? She is particularly intended first to probe the outside world and the secrets of the environment to uncover and then to use the forces of nature."
She combines this nature to the 'outside world' (Line of universe), but she gives no gradations in space and time.
Intuitively she feels the relationships in everything that surrounds the human being - and the relations she later explicite will describe in 'To educate the human potentential' (1947) - and trying to translate to a scientific attitude.

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7 See framework.
8 The method, p. 16.
9 A Dutch collection of lectures, titled: "Through the child to a new world" (Door het kind naar een nieuwe wereld), Kinheim uitgeverij, Heiloo, 1953, P. 180

Scientific approach to education
Maria Montessori approached education in a scientific manner. This same attitude she asks from teachers. Around the quote: *"The man of science is not the wielder of instruments - but the knower of nature.",* she appoints the desire and need to train the teacher better*: "We left the educators on the threshold of the experimental sciences and we forgot to give their noblest and deepest part - that which deserves the name of science."*[10]

In my view, this is a sound that we hear far more often and rightly! To supervise and initiate children into the world calls for a scientific, observational and often experimental attitude. Led by loving and enthusiastic teachers.
There are no manuals that lead every individual to adulthood. A child may hope to find a teacher who wants to understand it, who wants to guide it in the most appropriate way for the child on its road to independence. A teacher who is well trained to (learn to) see relationships. In the words of Maria Montessori[11]
: *"The teacher must pass through scientific preparation obtain not only the competence in the observation of natural phenomena, but also the interest in them."*

The freedom
An important prerequisite for cosmic thinking and working is liberty. It requires to be an entirely free human to experience and to investigate every aspect of the dimensions we live in - space and time - without any hindrance or limitation of others. The current education now on earth, depending on the cultural situation, has many barriers and/or limitations. Often this is politically motivated, religion plays a decisive factor or cultures will they stick to old traditions. Even in countries which call themselves open and democratic there are barriers and limitations: education only as a defined curriculum is obstructive and limiting.

Maria Montessori takes a clear stand by the following quotation:[12]
"The idea of freedom, which the pedagogy must animate, is on the other hand universal. It means the liberation of the life that is still hampered by an infinite number of obstacles which hinder the harmony of organic and mental development ....A Large part of education is based on a principle of repression that sometimes almost borders on slavery and thus also the school is governed by the same principle."

Later she states it more sharply:[13]
"The teacher should not work in the service of any political or social beliefs, but at the service of the whole man, who is able to be self-disciplined in free will and judgment to use, unperturbed by prejudice and undistorted by fear. "
Maria Montessori saw all the obstacles that could hinder a free development; in other words, she saw the relations which could hinder a healthy and free development.

The prepared environment
Through her thorough observations she was capable to make 'Goldilocks' (favorable conditions) of obstacles ; the environment was properly prepared.
I mention only a few striking examples of the prepared environment concerning the school benches.[14] She replaced the benches with light tables and chairs.
The motivation Maria Montessori found in:

- *"Liberation from slavery."*
  No more (literally) nailed in one place to sit in one position, but let themselves choose the attitude that like most: health promotion.
  Themselves can choose where and with whom they sit down and work

10 The method, p. 16.
11 The method, p. 74.
12 The method, p. 20-21..
13 To educate the human potential, P. 8-9.
14 The method, p. 72-74.

together: the light tables and chairs are easy to move the children themselves. There is a free choice of work.
Stillness (inaction) and not allowed to talk are impediments to development.

- No uniformity, but plurality in the classroom; like life itself.
- Learning self-discipline.
  In the beginning the children had to get used to the new furniture and the resulting freedom. There were often chairs overturned.
  - *"The border of freedom is the public interest."*
  - *"The form of freedom is well-educated in manner and behavior."*
  "We call someone disciplined when he is master of himself, so he is able to control himself when the demands of life ask, and where necessay he is able to follow a rule of life"[15]
- Hygiene.
  Under riveted school benches easily accumulates dirt that is difficult to remove.

The materials obtained by prolonged observation and thorough study (more on that later), are carefully chosen by the teacher to match the development of the children.
Although very important, but these are not just the materials that define the 'Goldilocks' conditions, the entire environment in school was adapted to the size of the child so the development can proceed undisturbed.

- By lowering the typical high windows (so the kids could not look outside during class) 'the outside world entered the school'.
- The school entered the outside world by including the construction of a garden.
- Tables and chairs were light and had the size of the children.
- Everything in the school was made easily accessible for the children: the height of taps and sinks, coat racks, door knobs etc. etc.
- There were different corners in the classroom where the children could rest, read, paint etc.

The main factor in the prepared environment is the teacher. Besides she has taken care of all the above, the teacher is very well prepared for her task. In all she is the leading, motivating and inspiring example for the child. She does not do by herself, what she does not want to see with the children. She'll do anything to arouse curiosity, to inspire, but above all to observe.

The observing teacher in the living school
The observant teacher in a carefully prepared environment is therefore a very strong example in which and through which the working formula of cosmic evolution is visible.

Maria Montessori was especially in this very progressive and therefore able not to build a 'institutional' school but a 'living' school. The previously mentioned scientific training of teachers - learning to see all relationships as much as possible - play in this a decisive role.
Through highly targeted observation, the teacher gets information on the progress of the developments of each child and the progress of developments in the group.
In addition, the teacher keeps distance and observes; signals and, if necessary, intervenes, records.
In a group with a leader acting as described above, there won't be something quick 'fix; institutionalize '. Developments will remain alive and surprisingly both the group and each individual child; every opportunity can be exploited, every positive initiative for development is approved, the atmosphere in the group is confident, and secure.

Now reaching the above stated tasks certainly are not easy, but a teacher who is open to all relationships which he/she identify, who will talk about that with colleagues and other stakeholders, is working with the children and the school to improve its ability to handle issues .

The school develops and continues as a living school.

15 The method., p. 73.

The Montessori material

"Exercise and refinement of the senses has a definite value because of the observation field is extended and thus the basis for the development of intelligence is becoming more robust and richer. Through contact with the environment and its own research, the child builds his stock of concepts on which the intelligence can work . . . . contact with the environment is effected by the senses and movements. "[16]

Maria Montessori here describes the work of the child and the scientist in shell which uses the same methods as the teacher: observing , researching, building, learning.[17]

On the above scientific way is the Montessori material came about and the kids can work with it. Besides the above mentioned sensory material is also developed other material for learning writing, reading and arithmetic. Something later came the cosmic materials in biological and geographical development.

That Maria Montessori had a view of very many essential relationships is reflected in the creation of material for 'exercises for practical life': all household chores in the homes were made by children using their customized equipment (buckets, brushes, cleaners, etc.) The material to tie learning among others shoelaces or buttoning materials also belongs to this category.

Finally

Now we have got a little anthology of statements by Maria Montessori and we have received sight on her vision of what we call cosmic, ahead of Maria Montessori herself did use the term cosmic education.

It was a conscious choice to me to concentrate in particular on her first work ´The method´, to show that Maria Montessori´s cosmic thinking and acting started with the start of her pedagocical work in 1906.

If we read her other books, we will find therein a confirmation of that assertion. With her work ´To educate the human potential´ from 1947 as well as many lectures, she gave so many years later words and contents to her intuitively felt vision.

Does Maria Montessori gives a strict schedule what the teacher should do? In other words, did she create a system, a fixed method [18]of her way of working?

No, she supports with the developed materials that can be handled precisely, but she 'exemplary' describes the environment of the child and the world of the teacher which constantly are related to each other and to the world by the observing attitude of the child and the teacher.

And all of these relationships are not to be capture, not to be record: every man is unique in his own being and responds uniquely to the world around them. That does not make it easy to guide Montessori education.

The Platform Cosmic Education and Education Montessori therefore welcomes the framework that was developed in collaboration with Anne-Marie Poorthuis (2016). It is an open, neutral framework that gives access to all aspects of development and the relations between them.

It makes a cosmic approach to education possible !!!

Jos Werkhoven was born in Amsterdam in 1950. For thirty years (1972-2002) he was a Montessori teacher, director, trainer, supervisor and developer of educational materials. Since 1995 he has his own publishing house where he publishes educational material in the spirit of Dr. Maria Montessori. Besides publishing Jos is still very busy with the development of new educational material.Two years ago during the second congress of Big History he promised to build a further integration of Big History in primary education. At this moment he works together with a lot of Montessori professionals to study the relation between Big history and the cosmic education of Maria Montessori in the '(research)' Montessori platform Cosmic education. His aim is the enhancement of 'cosmic education' (the name of Big History in Montessori education).

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16 The method, P. 128

17 See framework: The line of ourselves: to discover and explore = understand and the working words in the formula of development.

18 *"What has been called with a few suitable term 'Montessori method', is actually a complex educational and social movement that originated directly from and by the child's revelations. We adults are only intermediary. The actual master showing new life values to the community, the child is."* "Through the child to a new world" (Door het kind naar een nieuwe wereld), Kinheim uitgeverij, Heiloo, 1953, P. 163-164

Mick and the fossil:

An example of how to get children involved in Big History

by Bea Heres Diddens

Drawings by Floor Hamburg

Do you have great interest in Big History? And do you really want children to get involved? But you don't know how? This article shows an example of how a Big History theme can be organized in such a way that the starting point is the child's natural curiosity. By letting the children take the initiative, and guiding them in the right way, a tremendous energy can be generated. You will see children's interest in their environment, the world, and the entire universe grow. You will notice that children will be stimulated to explore and will be increasingly creative to share their findings with each other in an original way.

I will tell a short story about a six-year-old boy. I just met him when I introduced '*The Animal Kingdom'* as a new theme to his class. Let's see what happened then…

A few years ago I worked as a substitute teacher, where I had the chance to take over a class for the four final months of the school year. And although this was a Montessori school, the former teacher obligated the children make a series of spelling and math exercises first thing in the morning. Only after finishing this they were allowed to roll out a carpet and pick a Montessori material of their own choice. I already experienced that I, as the new teacher, could not change the daily routine all of a sudden. So for the time being I went along with the current way of working. And then, there was that six-year-old boy, called Mick. This true story is all about him.

Mick

When I met Mick, I soon found out that Mick wasn't happy at all. He didn't like the spelling and math exercises. His working speed was slow, he was dreamy and easily distracted. He hardly made any progress and actually he didn't find joy in learning at all.

His mother wasn't happy either. The former teacher already warned me for the mother: *'She wants to talk to you every moment, etcetera, etcetera….. '.*
I tried to help Mick as much as possible. At one point, while he struggled with his spelling exercises again, he suddenly looked up and asked me this question: *'Do you actually know at what speed a raindrop falls down to the earth?'.*

We started a new theme: *'The Animal Kingdom'*. I prepared some lessons and made up a few activities. One day I brought a big fossil fish into the classroom. The plan I had with it, was inspired by the philosophy of the *'International Primary Curriculum'*. The so called *'Big picture': What do we already know? What do we want to know? How are we going to figure it out?*

The fossil fish

Here I will show how I introduced the fish fossil. First I put it in the middle of the classroom. Right from this moment I had the children's full attention. They gathered around the fossil, looked at it, and after a while they spontaneously started asking a variety of questions about it. They also shared what they already knew. I let the children just watch it, ask their questions and share their knowledge. After a while I asked them to write down their questions on post-it papers and stick it around the fossil. I gave the children plenty of time to let them ask all the kinds of questions they came up with.

At one point it seemed all possible questions were asked. At that moment we started to divide the questions in groups. What kind of questions do we have? We sorted out the questions and combined the questions that belonged together. We ended up with seven categories of questions: A till G. The next step was to figure out how we could find the answers to the questions.

A
Where did you find it?
Where does it come from?
How expensive is it?
Did you buy it?
Is it found or bought?
Where did you buy it?
Do you also have the tooth of the fish?

These questions are all about: **Where did you find it?**
I told the children, that the fossil belongs to my friend Ans.

How could we find the answers to these questions? We could interview my friend, we could write a letter, we could send her a mail or we could make a phone call.

B
Are there three of them?
How big is the biggest fish?
How big is it?
How wide is it?
How heavy is the fossil?
Do you know how many kilograms it weighs?
How many bones does it have?

These questions are all about the things that **can be measured** like the length, width or weight of the fish, and things that **can be counted**, like the bones of the fish.

How could we find the answers to these questions? We could use our rulers and scales, and we could just count the number of bones.

C
Will it be placed in the exhibition corner?

This is just one question about **the exhibition corner**.
How could we find the answer to this question?
Well, at the moment the question was asked, the fish had already been moved to

the corner. So the answer could be found by just watching it!

D
Why didn't you remove the rock?
Why is there a fish in the rock?
What kind of rock is it?
Is that real sand?
Is it a fossil?
Is it painted?
Is that a real one?

These questions are all about **what a fossil actually is.**

How could we find the answers to these questions?
I needed to explain what a fossil is, and how it is originated. Children could read information in books and do online research.

E
How old is the fossil??
From which time period it is?
Does that species still exist?
Is it a special fossil?

These questions are all about **the origin of the animal species**.

How could we find the answers to these questions?
We rolled out '*The Black Ribbon'*, a material invented by Fred Kelpin (a Montessori teacher, trainer and developer). Each child had an animal in their hands and stood along the ribbon in the right zone, the geological time period, in which the animal lived. At the very end of '*The Black Ribbon'* there is red zone of only a couple of inches or centimeters. That is the time the human beings started to live on the earth. We found out that the fish originated in the Devonian Era.

The black ribbon

F
Is it a fish?
Is it a shark?
Why isn't it a fish?
How is the animal called?
What is the name of the animal?
Is it a shark species?
Is it a fish?
Is it a dinosaur?
Is it a fish? What kind of fish?

These questions are all about **classification.**

How could we find the answers to these questions?
We learned about the classification: invertebrates (without a spine/backbone) and vertebrates (with a spine/backbone). The invertebrate are divided into protozoa, sponges, etcetera, and finally the vertebrata. The vertebrata are divided into fish, amphibians, etcetera.
The main characteristics of the species are to be seen. So the children could find out that this animal belongs to the fish. A fish is covered with scales and slime. It is coldblooded and breathes through its gills. They live in water and their eggs have no shell.

The classification of the animal kingdom

The classification of the vertebrata

G
Does it have legs? Or not?
Can it swim??
What does the animal say?

These questions are all about **the characteristics** of the animal.

To solve these questions, we make use of *'De Dierenbak'*, literally translated

'The Animal Box', a learning material invented by Nico van Ewijk (a Montessori teacher, trainer and developer). It consists of a wooden circle on which the child can put a picture of the animal it is interested in. There are seven big wooden pieces, with the main questions about the animal on it, which can be placed around the circle. With each main question a series of sub questions go along. The questions can be asked about every imaginable animal.
The child just adds an introduction to his answers, makes some drawings, and the essay about its animal is completed.

de dierenbak

As soon as we sorted out all the questions, and found out a way to solve them, it was time to decide who is going to figure out what.
And also, we gradually started to think of our presentations. In what spectacular way would we like to share our findings?

Regarding point A about finding the fossil, we decided to send an email to my friend Ans. She replied with a comprehensive and interesting email. She found the fossil at the *'Dinosaur National Monument Park'* in Colorado. This park was created in a place where many remains of dinosaurs were found. They think the animals were killed by a disaster and ended up in the bend of a river and were covered by sand. Researchers discovered the place and others put a building over it. Now you can see the bones they have found. It is very impressive.

My friend sent some pictures of the inside and the outside of the building. She wrote about the guide to fossil bones of the quarry. A map inside the guide shows where to find the different bones of the stegosaurus. People made a replica of the stegosaurus in front of the museum.

In America there are also places where you can search fossils yourself, for a small fee. You need sturdy shoes and safety glasses. You don't want to get splinters in your eyes. And sometimes you need a helmet. Children should always be supervised by an adult.

The stegosaurus in front of the museum

inside the quarry exhibit hall of the museum

The people who are in charge tell you what to do. They let you know how long you may search. My friend got four hours. Her goal was a fish of about 4 centimeters long, and instead she found this enormous fossil fish. She told us the ins and outs of digging fossils, and how exciting it is. She explained how the layered rocks can carefully be split to find fossils. Her rock was too big, so people had to strip the overburden. At the end of her email, she sent us as a greet a 'high three': the footprint of a dinosaur.

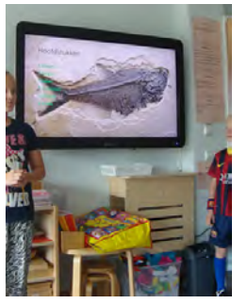
At this point I noticed once more that things chosen from real life, like the big fossil fish found by my friend, really impresses children.

My friend Ans digging fossils

The 'high three'

Regarding the other points: the work was divided smoothly. The children worked full of enthusiasm and showed a lot of activity. For example: the children measured the fish, but didn't stop. They just went along measuring themselves. They determined which child was the longest, the shortest, the lightest, the heaviest, etcetera. They put all in tables and graphs are made from it. The presentations were spectacular!



children at work and presentations

The creativity continued in everything. The children gave our trainees a parting gift of an old fishing rod with a variety of beautiful colorful fish on which they wrote some nice words.

fishing rod with goodbye gifts

Mick in the end

So, how about Mick? Where did he stay in this story? What was his part? After his question about the speed of a raindrop, I was not surprised to see Mick flourish. He immersed himself completely in '*The Animal Kingdom'*. He changed into a boy, who was lively, alert, nosy and interested. His working speed went up by leaps and bounds. He learnt a lot. And even more important he learnt with pleasure. In the end I saw a happy boy. And so was his mother!

In short:

- Put an interesting 'real life' object in the picture
- Let the children have a close look
- Give the children the chance to share their knowledge and ask questions
- Categorize the questions
- Find out ways to solve the questions
- Tell general information they really need to know before they get started
- Let the children study the issues they are interested in
- Let them cooperate
- Give them room to experiment and take initiatives
- Invite the children to present their findings to their peers

Maria Montessori in classroom

Bea Heres Diddens was born in Amsterdam in 1956. She has got over 30 years of experience in teaching at Montessori primary schools, with a great interest in 'cosmic education'.
She is interested in other cultures and has traveled, lived and worked in several countries around the world. She is board member of FAFA Foundation. FAFA works on a better future for underprivileged groups in Africa by encouraging and supporting small local projects (www.FAFAfoundation.org).
Bea has got a bachelor's degree in Biology and a master's degree in Special Educational Needs. She is also author of 'De Verhalenwijzer' (the story pointer), a material that helps children write stories (www.dearend.nl).
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Cosmic Education and Big History to Foster Development of Children from 0-6 Years

Vita Verwaayen en Tatiana de Riedmatten

The Earth is nearing many tipping points of social and environmental change which will be followed by a chain of impacts. Human impacts are the main contributors to these changes such as climate change and conflict zones, though they seem to be embedded in everyday life. Although the universe exists for billions of years and humans only exist for a relatively very short period, they have a huge impact on its environment. The contemporary human-dominated global environment system conceptualizes the idea of the Anthropocene, in which human beings view themselves as standing above nature instead of being part of it (Palsson et al., 2012). Therefore it is important to understand the interlinkages between human behaviour, policies, environment and the universe and why people should become conscious of the relationships between humanity and the cosmos. In order to foster positive relationships between humans and their environments, becoming aware of ones relationship with the universe is essential.

Young children will become the decision makers of the future, thereby strongly contributing to individual, national and global change (Hägglund & Samuelsson, 2009). Maria Montessori also recognized the importance of the next generation, which she called *the new shining hope for humanity* (Montessori, 1951:23). Montessori developed her own method of education especially for primary and secondary education in which she adopted the concept of cosmic education. Cosmic education provides a framework by raising awareness of the relationships between human and the universe at young age. Therefore, this paper will focus on cosmic education based on the principles of Montessori.

Montessori states that '*education capable of saving humanity is no small undertaking; it involves the spiritual development of man, the enhancement of his value as an individual, and the preparation of young people to understand the times in which they live*' (Education and Peace, 1949:30). These ideas are in line with the ideas of Montessori about cosmic education and shows the potential of education in raising a new generation of young children with better relationships with nature. In implementing cosmic education, Montessori believes that from the age of six and onwards children are more open to be educated. Preschool is seen as a preparatory environment, but no extending research seems to exist around this age group concerning cosmic education. For this reason, this paper will explore the possibilities of cosmic education between the age of 0-6 years, based on the principles of Montessori.

Firstly, this paper will examine the definition of cosmic education and its relevance for child-development. Second, it will show how cosmic education relates to children from the age of 0-6. Finally, possibilities of the implementation cosmic education in day care centers and primary schools are studied. Practical tools are provided for implementation, while emphasis has been given to the roles of the educator, materials and the learning environment. This paper is conducted through a literature study with additional information derived from interviews with

Montessori schoolteachers and pedagogical staff members, as well with my own observations during visits at two Montessori preschool classes and two Montessori day care centers.

Definition cosmic education

As mentioned above, cosmic education is important for development of the self. Now this paper will turn into the conceptualization of cosmic education, which comprises a very broad and large range of content and therefore beholds no singular definition.

One quote by Montessori has often been used to define cosmic education:

"Since it has been seen to be necessary to give so much to the child, let us give him a vision of the whole universe. The universe is an imposing reality and an answer to all questions. We shall walk together on this path of life, for all things are part of the universe and are connected with each other to form one whole unity. This idea helps the mind of the child to become fixed, to stop wandering in an aimless quest for knowledge. He is satisfied, having found the universal centre of himself with all things". (To Educate the Human Potential).

Cosmic education is about evolving an overview of the world, in which interconnections are recognized. It constitutes the development of a cosmic view through becoming aware of interdependencies and interrelationships existing in the cosmos. Through this, a child develops its own cosmic vision and becomes an active participant itself. This will help children to become responsible adolescents, feeling a sense of gratitude and wonder for everything that exists. It is a form of holistic education through which the child can develop itself in its full potential, as well in relationship to nature and the environment. As Hilson states: *"Cosmic Education is that form of relating the child to the universe and to humanity that will enable him to realise in himself all the developmental potential that is his own particular birthright."* Following this definition, cosmic education seems to constitute of two aspects. First, it is about developing the full potential of the child. Secondly, it is dealing with how human beings relate to the universe. These two aspects will be elaborated in the next section.

Developing the full potential of the child

Montessori states that school and parental education needs to build upon the strengths of the child himself (1951:20). A newborn is depending upon its caretakers, but soon it develops social, cognitive and motor capacities by itself. Therefore Montessori sees the child as the constructor of the adult. Parents and teachers provide the environment for the child to foster this development.

The full potential of the child not only comprises the development of social, cognitive and motor capacities, but also constitutes of understanding themselves and exploring their place in the universe. By doing this, the child will generate as sense of gratitude, wonder and fascination for the surrounding environment and everything that exists is essential. As a Montessori teachers mentions: "*through admiration and fascination of the universe, the child will find its place in this world*."

Relating humans to the universe

The relationship between humans and the universe is not one of a kind. Montessori points out the cosmic task through which humans are related to its overall environment. Fostering this awareness requires the recognition of interdependence and the interrelations within the universe. Interdependence and interrelations are both a way to acquire the cosmic overview as a life vision. Due to the awareness of interconnections and interrelations, a feeling of responsibility for the environment will grow combined with a sense of gratitude.

The notion of relating oneself and everything else as part of a bigger story is also often mentioned as a feature of cosmic education during the interviews. The concept of wonder seems to play a key role in cosmic education. Christa, Montessori preschool teacher, mentions that stimulating the wonder and fascination of the child, may enhance these feelings by which the child may recognize the uniqueness of it all. In this way the child will learn the interrelations between a concept and is shown the story behind it. For instance, when a child shows the teacher a caterpillar that she found in the garden, the teacher will display the wonder for the caterpillar. The teacher may explain that the caterpillar will eat flowers in the garden in order to become a butterfly. This butterfly will in turn pollinate the flowers which may be food for other caterpillars, animals and humans in the near future. This reflects the idea of making sense of the a caterpillar as a thing on itself as well as being part of a bigger story with the circle of life. Arousing the interests of the child through wonder and fascination can be achieved by

starting conversations. This will be clarified later on in the paper.

Relation cosmic education 0-6 years

In this section, the relation between cosmic education and children from the age of 0-6 years will be examined. Montessori describes the age of six to twelve as a sensitive period in which the child becomes more independent, develops a moral notion and able to think conceptually (Montessori, 1973). Because of this, telling the story of the universe is associated with children from the age of six and onwards. Montessori states that children from 0-3 are less prone to cosmic education since the child is merely focused on itself. In her view, the child needs a questioning and reasoning mind which develops at six years old. However, this paper will further elaborate the possibilities of cosmic education at the age of 0-6 years.

Children from 0-6 years seem cognitively not ready yet to discuss all seven thresholds of Big History. However, cosmic education at this age can be seen as a preparation of these children for later cosmic education in school from six years onwards. Basic cosmic concepts and ingredients can be exposed to the child, which may foster a cosmic foundation to build upon. This first contact with cosmic education can be adapted to the level of development of the child. Children are more prone to develop a specific skill within a sensitive period, compared to other periods (Panchanathan & Frankenhuis, 2015). During sensitive periods, a child will focus on developing a particular capacities by repeating the activity. Every child is developing itself in a way through cosmic education. It is the environment of the child that enables the child to explore, learn and develop. By reinforcing wonder, gratitude and fascination in a way which is adjusted to these sensitive periods and curiosities of the child, a child at every age can develop itself to its full potential.

Cosmic education at the age of 0-3

Children from 0-3 years are able to engage in cosmic education by adapting to their capacities and state of development. New-borns are able to actively gain knowledge through their senses and experiences, based on the sensitive periods of interests directed to particular experiences (Frierson, 2014). Children are born with the biological tendency to focus on things in their environments that grasps their attention. The materials of Montessori methods are especially designed to support and develop these interests. So when new-borns and toddlers are absorbing information through the senses, it can also 'absorb' cosmic education. Cosmic education starts with absorbing information at young age, which will function as a foundation for cosmic development at later age. During the first two years of infancy, the child starts becoming able to respond to and think about its environment (Keenan & Evans, 2009). Since these capacities are innate and might function as a starting point for cosmic education within every child. When a new-born becomes nine months old, it develops sustained attention (Keenan & Evans, 2009) and thus can focus and absorb information also related to cosmic education. At one and a half years old, more cosmic development can be constituted since the child developed its ability to think symbolically and it can mentally represent reality (Keenan & Evans, 2009). From 0-2 years old, the infant is very focused on viewing their surrounding from its own perspective. Therefore cosmic education can be adapted to the egocentrism of the child, by adapting to the relative 'small world' of the infant.

These different stages reflect the sensitive periods of infants. When infants become toddlers, the development of movement, language, orientation to the environment and order are central (Keenen & Evans, 2009). The ability to concentrate is shorter at this age compared to pre-schoolers, but sufficient in order to gain knowledge by absorbing information from their environment, imitate people in their surroundings and have different experiences. According to Montessori (1951) infants absorb information unconsciously to require basic capacities. Hence cosmic education can be established by handing materials, information and experiences which the child can absorb. Therefore from birth onwards, there are many possibilities to start cosmic development within the child. For instance, the sensitive period for order lasts from birth until five years old, while there is a peak between one and a half and two and a half years old. During this period, children focus on routines, order and patterns. Cosmic education can therefore be incorporated within these sensitive periods through visual stimuli, ordering games and puzzles.

Relating back to the definition of cosmic education, during the observations it seemed clear that infants and toddlers too are able to develop a sense of gratitude, wonder and fascination for their environment. At young age, cosmic education is about experiencing and exploring all relations and processes in their close environments and the universe. At the age of three, toddlers prefer to act autonomous, which underlines the principle of Montessori 'help me to do it myself'. This can also be related to cosmic education in which toddlers start

linking experiences, processes and concepts. For instance, at the Westerdok day care center, Tess (2) expects to have a sister soon after spring. She says: 'I was also in moms belly when I was very young'. This shows the ability of an infant to link a specific situation to a bigger story, in this case the similarities between her expected sister and her own birth. Although infants from 0-3 years have a more egocentric worldview, they absorb immense amounts of stimuli. Therefore, cosmic education at the age of 0-3 years is contributing to the development of more cosmic conscious generation. As a Child Care manager mentions in an interview: "The child day care centers function as a first encounter with cosmic education."

Cosmic education at the age of 4-6 years

From the age of 4-6, children start developing a sense of abstract thinking (Magid, Sheskin & Schulz, 2015). Therefore, at this age, children may develop a further understanding of the interlinkages and relationships between themselves, their environment and the universe. An example; two pre-schoolers were working on drawing a world map model from a puzzle while talking about the countries. Sixton (5) asked Lukas (5) where they live and Lukas points it out on their drawn map. Then they talk about the world as part of the universe and about where the universe ends. Lukas tells me how the world came into existence and that 'The universe stops when there is nothing, but the nothingness is never ending'. This example shows that Sixton and Lukas both developed their ability to think abstractly and can therefore participate in deeper conversations related to the universe.

Since sensitive periods for pre-schoolers behold learning about numbers and more refined language (Keenan & Evans, 2009), many aspects of cosmic education can already be presented to the child. Just like children from birth to three years old, this can be constituted by presenting and showing the children the wonder of the environment, and stimulate them to explore their surroundings themselves. For instance, a girl from the age of four started to explore the wonder of a dandelion. She picked one from the schoolyard and started picking the leaves one by one thereby counting them. The teacher asked her questions about the origin of the flower to which she responded with the knowledge she just generated. This is an example of cosmic education which fits nicely into the sensitive periods of the child. By picking the leaves, pistil and stamens, the girl experiences how these flower parts are part of a bigger story. The teacher concluded this experience by involving the children in class in sharing the wonder and gratitude for the dandelion herself.

Although in general, children start to think abstractly from the age of four, there are many diversities between children in their development. This is why it is so important to adapt to the individual level of the child and react to the interests of the child. This can be done by have discussions and conversations about cosmic concepts. By doing so, children will be challenged to question realities without taking everything for granted. These conversations can start at young age and can deepen along the cognitive and verbal development of the child.

Children between the age of four and six are very independent and able to explore their environment themselves. They have their own interests and by stimulating these interests and wonder, they can be stimulated to develop themselves to their full potential. Cosmic education is therefore highly suitable to implement at the age of 4-6.

Cosmic education in practice at young age

The prepared educational environment in a Montessori school and the Montessori material

The Montessori method and materials have been developed for and aimed at children from preschool age (and over) in order to encourage them to see and experience the relationships and processes in the world and the universe. They are also designed to encourage and develop a sense of responsibility, and to help the child to care for themselves and their environment. This attitude of encouragement to explore is completely embedded as a core principle of the Montessori method. Toddlers and preschoolers really do like to explore and find things out for themselves. The Montessori materials, teaching methods and the prepared Montessori classroom environment are all intended to further stimulate children's intrinsic motivation to explore and learn.

The Cosmic approach is embedded in the Montessori Method as a whole; a child learns carefully and respectfully to deal with their own body, with nature, people, animals, plants and their environment. In addition, the teacher will also make the child aware of relationships in the Universe by making them more explicit and clear during lessons and by admire and discuss objects the children brought to school or experiences they had in nature, their homes and living environment.

From 1-1 ½ years onward (or when the child can walk and stand upright steadily) in a Montessori environment much attention is paid to care and respect for the environment and there are all types of household materials present in the classroom environment. The materials are made child-sized so it can use the materials more easily and independent.

By giving children material to meet their intrinsic motivation and showing that household activities can be done well by themselves allows children to then experience how nice and satisfying it can be to do household chores and how pleasant it is to live and work in a tidy and clean environment. This reinforces the child's ability to care and take responsibility for their classroom and environment. They also find that practically everything has its own place and how things can best be handled and moved. The contribution of this education is to result in children growing into emancipated adults who take responsibility for the care of their environment. As a Montessori-teacher you should make children aware of the link between the care of your own immediate environment and global environmental responsibility. (i.e.: you do not throw trash on the floor in the classroom, and also not in the city or countryside and teach them about recycling and division of paper, plastics and vegetable waste).

Cosmic education from 0-6 years

In education and development from baby to toddler, it's important to start with activities that have a clear function for the child in everyday life, such as cutting fruit and vegetables for lunch. Everything should be as realistic as possible in such activities, so you should allow the children to use sharp knives, just as you would use yourself. If the child experiences how well you can cut with a sharp knife and at the same time learn them how to deal safely with sharp blades, this will encourage a sense of responsibility and caution while working or learning. Were you to give the child a blunt knife that does not cut properly, without proper instruction, the possibility that they will injure themselves actually increases. Giving a child a real tool allows them to use and explore more of that tools functionality, giving them more insight into how the tool, and the world, works.

From the ages of 0-3 the child develops the ability to think more abstractly: we first teach the names of various kinds of fruit being eaten at lunch, then learn to recognize the same kinds of fruit, but then in the form of a figure of wood or plastic, and finally to be able to recognize the kinds of fruit and name them from an image. The final step is then to discuss color, shape, texture and taste of different types of fruit and whether the children like the taste and texture. When discussed in a group, they also will learn that it is not necessarily true that when they like a type of fruit, that all the other children like that as well.

When preparing the learning environment for children aged 0-3, you will remain still very close to the vicinity of the child by using concrete and practical materials to develop the senses and motor activity. Around 4-6 years you can then expand on this with more abstract material and objects. For instance, you can give a child from 4-6 dried beans to sort by color and shape to practice their fine motoric skills and ability to discriminate between the shapes. When you give dried beans to a 1-3 year old; they will probably just put them in their mouth and try to chew or swallow them.

The child of 0-3 years has yet to develop full control of his/her senses, motor skills, language, independence and abstract thinking, and is still very egocentric. The child of 4-6 is able to empathize more with others, and is becoming sensitive to social development.

A very important step in a child's development to independence is dressing and undressing. With children from 0-3 years it is important to develop the sensory-motor skills in order to be able to dress themselves in everything from a winter coat to gym clothes to a swimsuit. If the child herself has learned well how to dress, she can then help other children at some point in dressing and undressing. From 4 years old the child is more open to the social development and will be able to see that someone else needs help, and know when and how it can provide assistance.

Overall, you can say that the development of children between the ages of 0-6 years runs from complete dependence to near total independence, from simple concrete perception of the world to more abstract thinking, and from totally self-centered to more social, empathetic thought and behavior.

Cosmic education in the Montessori-schools of today

Despite that Maria Montessori originally saw Cosmic education as one of the basic starting points for her method, you can see in practice that often Cosmic education in Montessori schools is treated as a minor topic and is not fully integrated into daily work.

The main focus in teaching children from 0-6 tends to lie on language and mathematics, as far as Cosmic Education is concerned the most work is done on biology and geography, as there is a large amount of material developed for these subjects. Many Montessori schools use printed learning methods to teach history and biology. The beauty of Cosmic education as Montessori intended is that you can start from the whole of the universe and use that as a starting point and a guide for the whole education of the child. The origin of the universe, galaxies, life and humans also offers numerous starting points for language and math education, developing independence, creativity and social behavior, and literally all subjects can be interconnected through Cosmic education.

There is a method specially developed for Cosmic education in Montessori schools; DaVinci (name of method and publisher) with comprehensive manuals, some materials and worksheets. This system is based on Montessori principles and allows children to work independently. The intention is that teachers and children can gather extra material themselves. For children from 4-6 years there is some material available but the method is clearly focused on the age groups 6-8 and 9-12 years. In practice, however, it is still a common complaint that the information in these types of methods, firstly is quickly outdated and secondly is not very compelling; you go through a regular cycle of lessons for three years, related to the timeline from the Big Bang to Modern times. As a Montessori teacher you should therefore choose to use a method to give freedom to lessons learned from what interests the children at that time, what they bring to school and what is happening in the news.

On Montessori schools teachers of the youngest children (4-6 years), usually develop their own materials and associated classes, which they can then use as needed and adapt them to current events. What you usually see is that the materials and lessons are arranged by season : lessons on the spider and mushrooms in autumn and flower bulbs and tadpoles in spring. In addition, in all the classes there will be mostly a timeline of the year, which lead up to and indicate the days, months, seasons, birthday parties and trips and make the progress of the year visible and tangible to the children.

Cosmic education and Big History with children from 4-6 years in a Montessori school

Inspired by the course Cosmic education and Big History as a Montessori preschool teacher myself, I started my search for materials to educate young children about (the creation of) the universe, the planets in our solar system, the origins of life, and the evolution of man and found there was not a lot available. From my years of practical experience with young children I know that they find all these subjects immensely intriguing. The lessons I have therefore given about the origins of the universe and our solar system worked very well with the children in my class. Most preschoolers want to learn everything about the world around them and their place and time in the Universe. They like to see an order in time and space and the links and connections between objects and concepts. I told, for example, during a lesson on birds that it was now believed by scientists that birds evolved from dinosaurs, which information was taken home and transmitted to their families by several children who normally do not tell a lot about school.

Thus, it appears quite possible to start from a very early age with Cosmic education (and Big History material) in a way that allows children and teachers to have as much freedom as possible in order to respond to individual needs and interests and current events and are not tied to a very tight schedule and a mandatory order. This approach seems to produce very effective results.

Big History and the eight thresholds can therefore form a good basis for lessons based on the Cosmic education approach within a Montessori school. It offers a time structure and organization which appeals to children and provides teachers with a guide or plan to shape cosmic education, a backbone on which many educational goals can be placed. It would also be possible to integrate literacy and numeracy education in this overall approach, to create a truly unified educational approach. This does, however, require a lot of prior knowledge and preparation time of teachers which is not always easy to realize in practice.

Conclusion

This paper shows how young children from 0-6 years old relate to cosmic education. Throughout the paper, it has been made clear that cosmic education contributes to the development of the child to full potential. The principles of Montessori are a starting point for cosmic education. Although there is a general assumption that this starts at the age of six, this paper has shown that cosmic education can also be constituted at young age. In order to do this, children can be exposed to the wonders of their environment so they develop a sense of wonder, fascination and gratitude for their environments and human relations.

Cosmic education at young age is recognized as a first glance at the complex interrelations within the universe. Nevertheless, this paper shows how cosmic education is not just preparatory, but the start of a child's conscious of being an human in relation to the world and its environment. Children learn how to explore the environment by themselves and learn appropriate basic cosmic concepts based on their sensitive periods. In doing so, the child will develop to its full potential and thereby prepares itself for the Big History story.

This can be practised by using Montessori materials, as well as using the direct environment to let children experience and explore the cosmic relations themselves. The teacher stimulates the children to act increasingly more independent and provides the required materials for children at a particular age and for their current interests. Whereas the teacher also functions as a model, it should be emphasized that the teacher needs to keep exploring the existing cosmic interrelations him- or herself, as well as together with the children by showing them the wonder and gratitude for the environment.

In conclusion, this paper exemplifies that cosmic education and development is not fixed, but a gradual and dynamic process which differs per person. Teaching and receiving cosmic education is not age-related, rather cosmic education should be adapted to the abilities of the child since showing the wonder of the universe is not age bounded. Wonder and a sense of gratitude can be experienced at any age at will foster the future development of the child.

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Tatiana de Riedmatten is a primary school teacher on Montessorischools since 1999. As a Montessori teacher, Cosmic education has had always her interest, to teach about science and the Universe. Since she is working mainly with the youngest children, 4-6 years, she have always been searching for ways to teach these young children science and global awareness from the start. When she learned about Big History she found that an ideal approach to use within the cosmic education.

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Cosmic Education and Big History for toddlers and preschoolers

In my experiences as a teacher of preschoolers in a Montessori school, observations in a day care centre based on Montessori-principles and as a mother of two; I've seen that it is possible to start cosmic education at a very young age.

As a Montessori- teacher you provide an environment with materials that are easy to access and handle, that are attractive and that trigger children's natural curiosity and urge to develop.
The Montessori-materials support their development from dependent to independent and from an egocentric view of the world to a wider view of the world.

An example of how this can work: a series of lessons (learning line) that starts with the concept of a ball and will lead eventually to understanding of the globe, the earth and its place in the universe;

0 -1 years A baby you'll give a ball to explore with all its senses and let it discover all the possible things it can do with a ball.

1 – 2½ years From about one years old, you show the ball shape in all its varieties in the environment and with different textures, like a rough skinned peach and a smooth nectarine, different colors, in the real world and in pictures and of course you give the name of the shape.

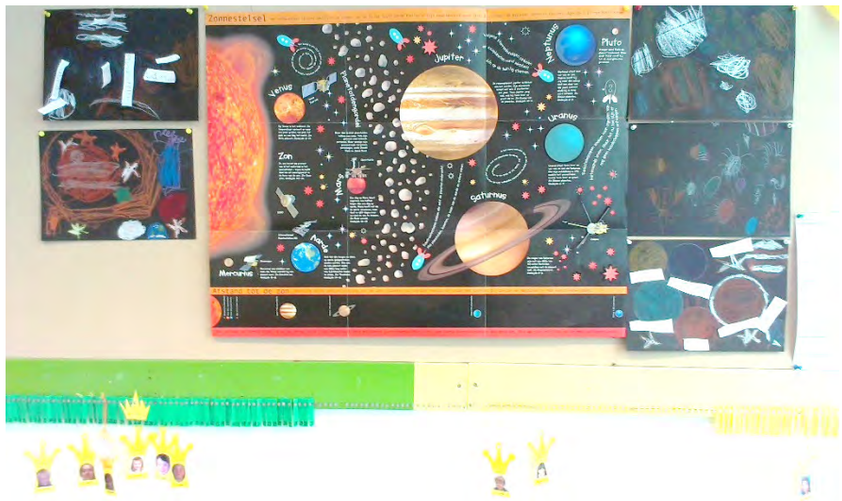
At the same time you name and give the child natural materials to explore and sense ; like water, sand, earth, grass and stones. At this age the child's exploration is already more directed and should be become more purposeful. We can see this in daily life when working with the child-sized household materials, materials that develop skills to dress themselves properly and in this case;
sorting different shapes and colors of fruit and cutting them in more different shapes to prepare for lunch and of course taste them during lunch and experience different smells, tastes and textures while eating.

2½ – 4 years From 2½ years on you can start to give lessons based on the Montessori Geometric Solids that show the characteristics and differences between, for example, a ball and a cylinder;
a ball can roll and spin around an axis, a cylinder can roll, spin and tilt as well.
This is the most sensitive period for learning new and difficult words so even words as 'sphere' and 'ellipsoid' can be taught.

4 – 6 years When the child is around 4 years old or the teacher observes interest in more abstract and complex concepts, you can give them the Globe (earth) with water and land created by sandpaper (e.g Blindfolded to feel if there is more water or land).
From here you start with giving the names of and showing the land and water forms like I'll show you now in a small lesson and for that I need a volunteer;

Land & Water Forms with clay – Show the child a container with clay/plasticine and say:
"This is land" then show a similar container with water and say: 'This is water'.
Them you'll ask the child to cut out a circle or ellipse out of the middle of the layer of clay and to put that in the container with water. Then you pour out a bit of water from that container in the little hole in the clay and say:
"Now you've made an island and a lake". This was the first step of the lesson, the

next step is to exercise with the words like; "Can you point for me to the lake, can you give me the island?" The last and third step of the lesson is that the child can actively say the words when the teacher points at them and asks: "What is this?".



After this you can discuss and explain about other spheres in our solar system like the Sun, the other planets and their moons.

You can continue in this theme by giving the child the Globe of the continents with the continents in different colors and the 2 dimensional representation in the form the Puzzle Map where every piece is a continent in the same corresponding color as on the globe. Finally you can then show the ultimate abstraction to work with: a drawn map of the world.
Together with the child you can then look up features on the map and after it gets familiar with it, the child can work and explore the map and other maps on its own.
The child can also make a representation of the world out of paper or you can introduce the Animal Continent Box.

When I was doing research for the Dutch Montessori platform Cosmic Education, inspired by the Big History course and Cosmic Education, I started to tell the preschoolers in my class as a group about our solar system and its origin, the Sun ,the planets and what they are made of.
I found that I got their immediate, intense interest in everything I told them and they started to ask more questions about the universe. They also asked questions where we have (not yet) the answer for. As a Montessori-teacher you will show them that teachers and even scientists have not got all the answers yet and can stimulate them to find answers, either together or all by themselves. You can encourage them to be in the future a scientist who finds these answers;

Through the child to a new World.
This last sentence is also the title of a Dutch publication with a selection of lectures by Maria Montessori; 'Door het kind naar een nieuwe wereld' (published by the NMV, The Hague 1941), The title is from Mrs. A.M. Joosten, who selected and translated the lectures and chose this title, inspired by the work of Montessori.

Marg Paulussen has a PhD in Biology and several years of experience in teaching Biology at secondary schools as well as Cosmic Education at a primary school. Acknowledging the importance for children as well as adults in urban surroundings to be in touch with nature, she likes to discover nature with children of the 'Delftse Natuurwacht' (Delft Nature Watch) and the IVN Institute for Nature Education and Sustainability.

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In a Montessori School different school subjects such as history, geology, biology, science, astronomy etc. come together in Cosmic Education. The subdivisions we use in our Montessori Primary School Cosmic Education: 'Universe', 'Earth', 'Life' and 'Civilization'. We analysed what would be desirable for an optimal 'prepared environment' inside and outside a Montessori primary school building. Children have to *get in touch* with the environment, inside as well as outside. They learn and understand better by actually *touching* things. To accommodate sensorial, motoric, artistic, cognitive as well as spiritual education, a 'prepared environment' is needed, by which children are inspired to work on projects of their interest. In a Montessori School there may be a classroom for arts and crafts, a science lab, a workshop, a kitchen, a restaurant, a library, aquaria and terraria with animals, a bird observatory, etc. The inside and outside of a Montessori School for Cosmic Education are connected. Outside pupils of every age can *dis-cover* nature in a school garden, which should be attractive in all seasons and harbour a great diversity of animals and plants. In such an environment, children are able to discover relations between things and (with the help of their teachers) to put everything in a bigger context.arg Paulussen has a PhD in Biology and several years of experience in teaching Biology at secondary schools as well as Cosmic Education at a primary school. Acknowledging the importance for children as well as adults in urban surroundings to be in touch with nature, she likes to discover nature with children of the 'Delftse Natuurwacht' (Delft Nature Watch) and the IVN Institute for Nature Education and Sustainability.

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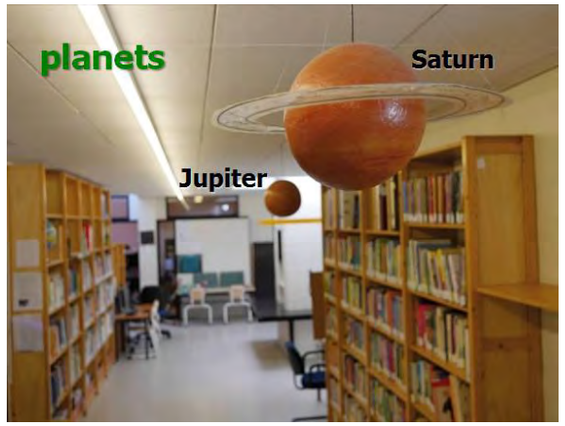
place to relax and listen or read


planets
Saturn
Jupiter


studio


music


gymnastics


playground


playground / work space


computers


workspace


Kitchen garden


compost


garden with different plants


and animals


extra classroom


microscope


terrarium with stick-insects


bee hives


terrarium with amphibians


pond with frogs


aquarium


bird observatory


kitchen to prepare food


places to eat


science lab

Characteristics of Cosmic Educators and Teachers

by Rietje van Stek-Lander

Assumption is that a Montessori teacher should be a cosmic teacher. Maria Montessori: “We discovered that education is not something the teacher does, but is a natural process which develops spontaneously in human beings. It is not acquired by listening to words but of experiences in which the child acts on his environment.”

In a Montessori school a teacher who works from a cosmic approach to education is a teacher with knowledge and experience of the anthropological / pedagogical and educational / teaching principles of Montessori education. The teacher follows, together with his/her Montessori colleagues, new scientific developments, including Big History, which can be critically incorporated into Montessori Education. The teacher is assumed to both have a “cosmic attitude” and to be able to encourage pupils to develop their own “cosmic attitude.” Children should be given an opportunity to explore, to discover, to see connections and to make decisions for themselves. Important words are independence and (co-) responsibility. The teacher here is the person who accompanies the child, as a guide and follows their progress. By inviting and asking questions, the teacher stimulates the child to explore. The teacher looks at the talents of each child and offers opportunities, motivation and encouragement to develop these talents.

The focus for cosmic teachers:

- take care of the environment, are observer and guide, know the materials
- stimulate children to find answers and let them discover new opportunities. Stimulate and do not restrict, ensure the good atmosphere, security.
- ask questions, encourage a questioning attitude and show your own curiosity. Compose big questions, think and speculate out loud. Give opportunities for play, experiment, risks, to fail and try again. Be open to explore new ideas from others and yourself
- help the children to acquire a cosmic vision on the world.
- give the children the opportunity and freedom to explore.
- enable children to discover new relationships in the world around them
- start from the whole and progress to the detail
- arouse the child’s wonder and admiration for nature
- arouse the child’s love for and gratitude to humanity

What can the child expect from his/her teacher? In essence: love and quality. Love the child, love your work and show real interest in the child. The child should know: I am noticed!

Rietje van Stek-Lander has experience in Montessori primary education and Montessori training at the Hogeschool Rotterdam. During the Montessori courses (including Cosmic Education) she gave, also abroad, she has experienced how universal this education is and how this education can provide the opportunities for children.

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Once upon a time….. there was a story to be told……

by Jos Werkhoven

Abstract: The author was a teacher for more than thirty years. The article starts with the story of a teacher: The story of everything! For a while, we follow the story in the classroom. But it is a long, very long story. So we leave the classroom and he writes us about his approach to telling this story of Big History to children of the age of six+. He calls his story "questioning" – questioning of space and time. He helps the children with three frameworks, which is the core of the article. For the framework of space he uses the concept of the *Powers of Ten*, developed by Kees Boeke. For time, he uses a framework that he developed himself: *The Lines of Life*, a set of four timelines for use in primary school. For questioning, he uses the material for sentence analysis developed by Dr. Maria Montessori.

The children are aged approximately six years and their teacher tells them the story because s/he thinks it is the best story of all time. And strangely enough, despite being a truly wonderful story, it is almost never told to the children! Most adults do not even know it! The teacher thinks that's very sad, because s/he believes that every child and every person living anywhere on earth, rich or poor, white, yellow or black, has the right to hear and to know this story. It's a long, exciting story and it will be unfinished when the children leave school at the age of twelve, but most of them will be able to continue writing and telling the story. Shall we just listen for a while?

"Good morning, dear children. Today, it is a very special day. I think and hope it will be a day you'll never forget in your life. Because today, I'm going to start to tell you a story. I'm sure that if you leave this school when you are twelve years old, I'll still not be ready with the story. Yet you will not get mad at me if I have not told the outcome. I think that you will be so curious that you, without my help, will seek further how the story goes. I expect, and frankly I hope also, that you will do that together, each of you with his or her own task. Anyway .... since we have a few years, I better get started now.

It is a story so special, so wondering, so exciting...the best storyteller could never have imagined it. The most remarkable is the fact that the story is about ourselves. And the story is not just about us or our school or our country...no...it's about all people on earth. And not just the people living today...no...it's about all the people that ever lived. I'm still not finished with my list, because it is not just about all people, but also about all animals. All animals of today and all animals that ever lived. And it is about our earth, about everything we can see on our planet... and it's even about the time when the earth wasn't there ..."

Bewildered Jacqueline jumps up and says indignantly: "But the earth has always existed!"

Our teacher is a gentle type and takes her waving hand lovingly and asks: "Tell us, Jacqueline, how do you know?" The answer rolls immediately from her mouth: "My mother says."

"And tell me, Jacqueline," continues the teacher, "have you asked your mother how she knows?"

"Of course," says Jacqueline. "But Mom says the earth was already there when people came."

"That's interesting," says the teacher. "And do you know when the first people came?"

Jacqueline hesitates, she does not know so well. The teacher responds with understanding and begins to say that we have a presumption when the first people came and also a presumption when the earth was created, but we are not sure.

Then I have a question for you all: "Do you know the difference between a presumption and a sure thing?" This question keeps everyone awake, and there are many answers quickly:

"What you know, you can prove it!"
"When you presume something, you think it's true."
"Yes, sometimes you think you know, or you know something of it, but you can not prove it."

After hearing many answers, and sometimes a real debate, the teacher picks up the thread. "I probably can help best by continuing my story, because that has to do with knowing something for sure or presumption. The most I'm going to tell, you probably have not heard before. And although we know a lot of things for sure, we have only a strong presumption how the story in reality has been told. Therefore, it is good if you remember two things. Try to remember well! There are only two, so it will certainly succeed.

Here comes number one, which we call "perception".
A perception is something we can see, hear, smell, feel, measure. Perception is nearly a sure thing: on any given day you can observe the same thing again, you can also talk or read about something that others have observed. In that case you say: "I know, I saw it too."

Number two is called "theory".
We think something happened a certain way, or could happen and we have seen a lot of things like that, but we do not know for sure. We have not seen it in every situation, and we do not know that we will observe it always that same way.
Thinking that something happened a certain way, or could happen, comes close to presumption. You may say: "I have much (or little) faith in this theory".
"So we know we have perceptions and theories. The story that I continue to tell has a lot of perceptions, but it also has many theories. I will tell you every time when a part of the story is a perception or a theory."

"Jacqueline, what do you think? I just spoke about the time that the earth was not there. Is that a perception or a theory?" The teacher asked Jacqueline the question, but there is a lot of noise in the classroom. All the children speak together. It seems that almost everyone has an opinion about it.

"The people could not write!"
"There wasn't life at all on earth!"
"You can never prove it!"
"How can we know?"
"First there was a great super-something!"
Smiling the teacher follows the heated debate a while, then he continues: "Let's be honest; I asked the question to Jacqueline and you all gave answers. We don't behave in that way, do we? We do not speak together; everyone gets to speak separately. If I hear all your arguments, then I can tell you that you all are a little bit right."

"Then it's a theory!" said Jacqueline aloud. She found that she still had the right to answer.

If you allow me, we leave the teacher alone with his or her class. In this limited space, we are obviously unable to follow six years of the story that s/he is going to tell the children. We have recently witnessed an enthusiastic teacher who, in any case, made it clear to us that he wants to tell the children a grand and universal story; he wants to tell them that they themselves are a part of it. Often it is not much more than a presumption, but they can continue and discover the story by themselves!

Hopefully you now are curious about how the teacher will develop it.
Our teacher likes simplicity. When telling a universal and great story, it is always useful to keep an overview, and s/he succeeds wonderfully. S/he describes his approach: *to query space and time.* The teacher uses a number of easily understandable and communicable frameworks, which makes the total space and time accessible to the children, so they learn to question space and time and to apply their knowledge. In order to support these applications, the teacher prepares an environment, a rich environment, through which the children can find their own way and can discover relationships. Also, s/he invites each child to create a private portfolio, which reveals how they are forming their relationships with the world. In summary the teacher gives shape to his or her mission "to make school" and accompany the child in his or her relationship with the world by:

- Telling a grand and universal story;
- To query space and time;
- To prepare a (rich) environment to draw upon;
- Inviting the child to create an own portfolio.

At the end of this article, I will tell more about "making school", the prepared environment and the portfolio. I continue the article now with the discovery of space and time.

Space

The young child of six years old is not a toddler anymore. As a toddler, they are mostly oriented to their own little world. At about the age of six, a child discovers that the world is much larger, that there is even a very large universe. The child wants to know what is beyond the stars! The child discovers not only that the world is larger, but that there also exists large worlds in very small parts!!! Give a child a microscope and s/he will investigate everything; it will open new worlds for them.

Kees Boeke, the Dutch educator and educational reformer, felt very good about what to offer children in primary education from the age of six years. (Boeke, 1959)

> *..... We all, children and adults tend to live in our own world ..... as we do, we can easy forget how vast the area of the existing reality is and our attitude may be slightly narrow and chauvinistic. It is necessary that we obtain a broader view, so we can learn to see ourselves in our relative position in the great and mysterious universe in which we are born and live. The school brought us into contact with different aspects of life but often they are not linked together, so the danger is that we collect a large number of separate images, without our realizing that they all form a great whole. Therefore it is important for our education as men, that we have resources available that can give us a broader and more continuous image of our world and thus a truly cosmic view of the universe and our place in it, so a cosmic orientation.*

Although Boeke wrote these words in 1959, they are still highly topical today. His brilliant idea appears as follows (see Figure 1a for a few of Boeke's original drawings and figure 1b for the colored edition of P. & P. Morrison).

Figure 1a: From Us in the Universe, the Universe in Us, Kees Boeke.

Kees Boeke and his children made a macro-trip from 1 meter height, where a student was seated in a chair on the playground, in 26 steps of the powers of ten to the frontiers of human knowledge. From the same starting position, a micro-journey was also undertaken. With the powers of ten, children travelled in 13 steps deep into the atoms of the human body.
Travelling and telling, the curiosity of the children grew bigger and bigger. They wanted to know! They wanted to investigate!

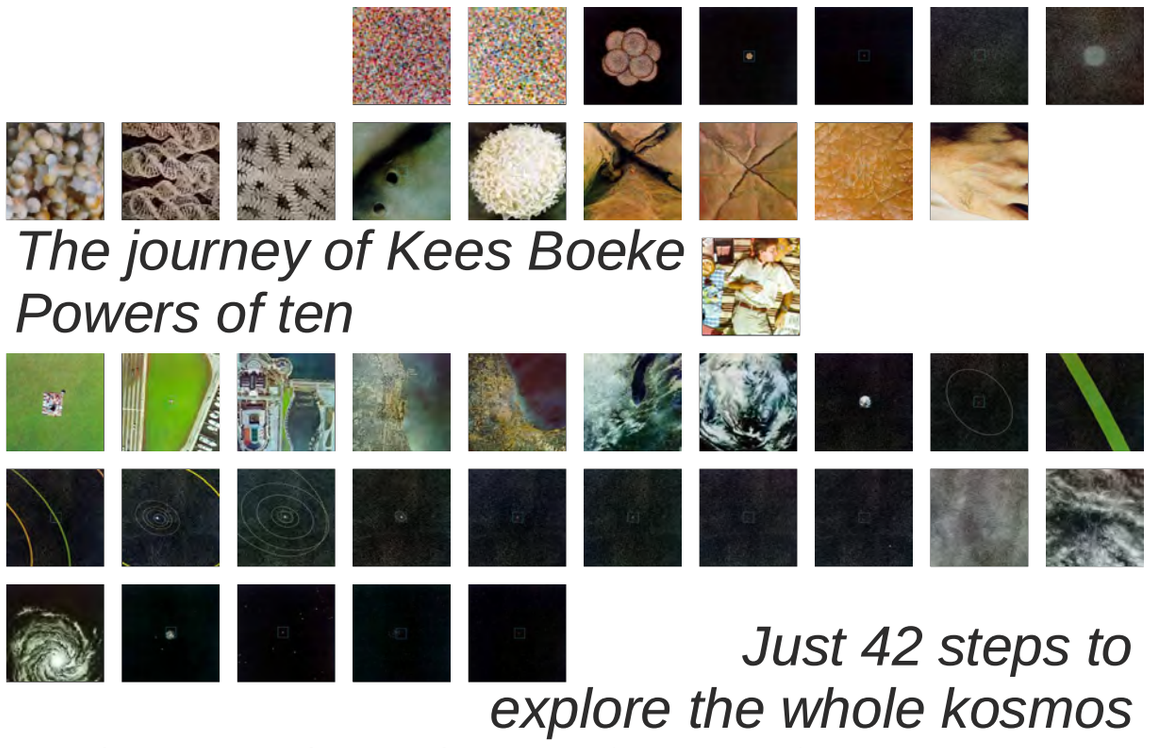


Figure 1b: From Powers of Ten, P. and P. Morrison. (Morrison, 1982)

Was that what was told to the teacher in training? – make the children curious by tickling them, then they want to learn naturally. I can tell, after thirty years of working with children, that I never saw any so curious and inquisitive as during the intellectual trip organized by Kees Boeke. They were, despite all their questions, satisfied, at rest; they better understood the complex world than ever before.

You understand that during this cosmic journey various teaching materials naturally arise. Not only in separate disciplines such as Geography, Biology and Mathematics, but also through integrated and interrelated studies. What a great value! The school, the teacher and the child make choices about the topics they want to offer and to investigate. In line with the powers of ten, the learning potential is not only in the subjects, but more in the way that the child learns to organize the access to knowledge through these topics. About this interesting information I will tell you more in the later sections. After the discovering of space, we now discover time.

Time

As a teacher, I was long looking for a way to organize knowledge that would have more value for children and could give more coherancy to the standard curriculum. On a cold November evening in the 1980s, I thought about a workable overview of "total time". I was drawing some timelines and suddenly found an overview.

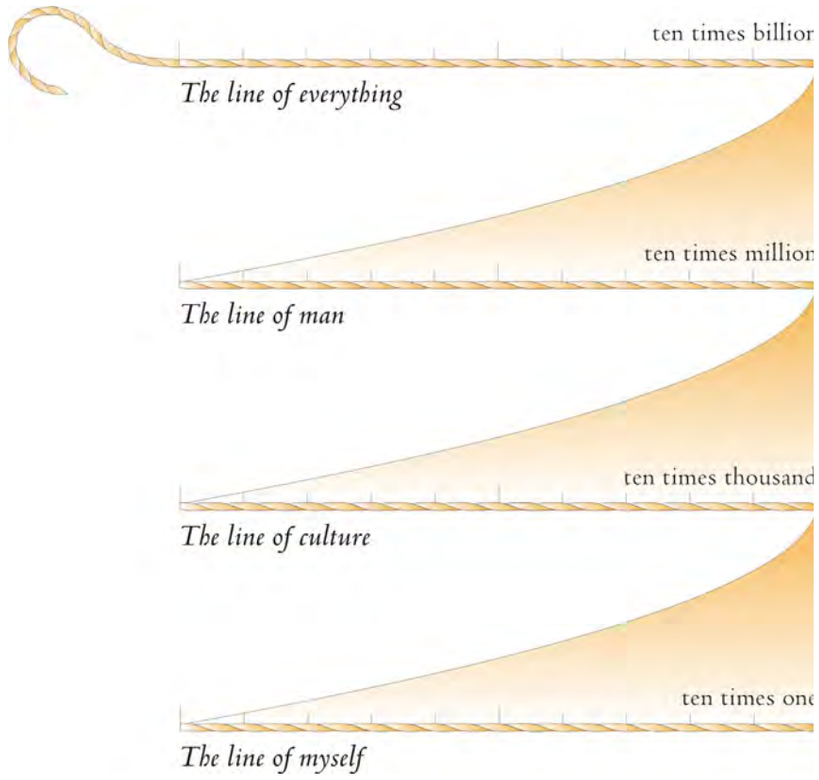


Figure 2: The Lines of Life, Jos Werkhoven.

Wow! It seemed I had addressed time! In one simple overview I understood:

- Total time, a line of everything = 13.7 meters long;
- Time of humanity = 10 meters, enlarged from 1 centimetre on the line of everything);
- Time of human culture = 10 m long, enlarged from 1 cm on the line of humans);
- Time of a school child = 10 meters, enlarged from 1 cm on the line of culture).

The mathematical beauty appealed to me, especially in relation to the history of everything: Humanity, culture and the child. Later, when I came into contact with the work of Kees Boeke, with its own mathematical beauty, it felt as an additional reward. I was very pleased to have "frameworks" that can give us an overview of space and time.

For me, it was clear that I not only should use this idea in my own classroom, but I had to share it with anyone else who wanted to use it. In 1997, I published the four timelines as, *The Lines of Life*, for schools. (Werkhoven, 1997) For this edition, every timeline had name cards and illustrations of moments of development to support the telling of the story.

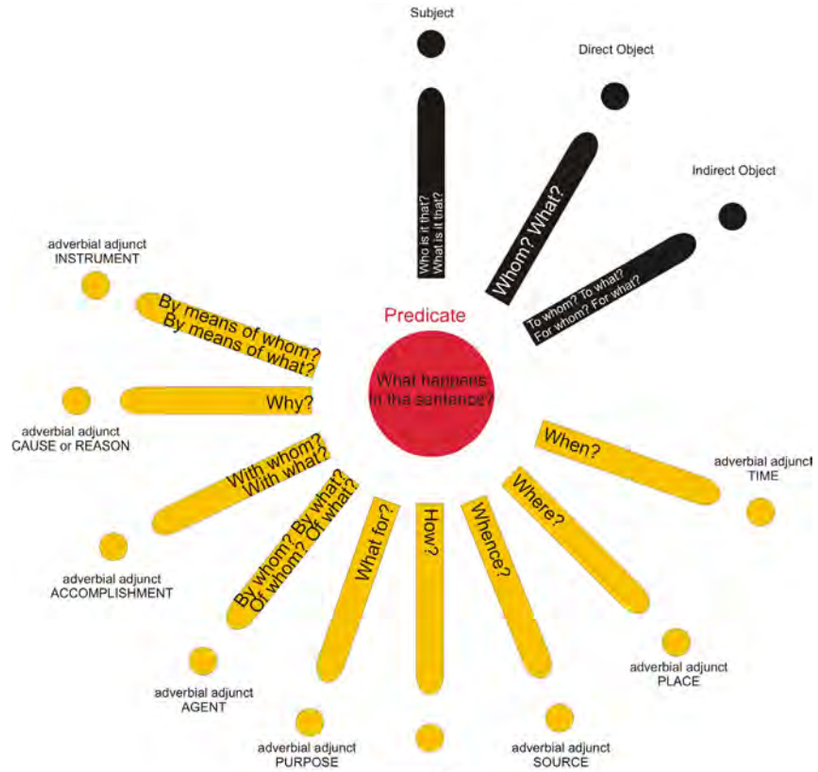
- The line of everything has name cards and pictures of the Big Bang; formation of matter; evolution of galaxies, Earth & life on earth; continental drift; development of mountain ranges; etc.
- In the line of humans, there are many illustrations and name cards of the ancestors of humans, their tools, moments for the rise of many animal species, ice ages, cave paintings, the first use of calendars, etc.
- In the line of culture, the emphasis is on universal human history as well as particular history (though present) of individual cultures. There are illustrations and name cards of the first appearances of agriculture and livestock, weaving, irrigation, shelters, writing, use of copper & iron, etc. The slave trade and important people such as Newton, Darwin and Mandela are also present.
- In the line of "myself", there are illustrations and name cards of birth, birthdays, the first time walking, etc. The child fills the line with their own pictures of various events.

The finest work in this series is always done by the children. Their own research and work are linked to the timeline. Books, artwork, fossils, handmade art objects, galaxies, earth and planets, and the other examples create what is essentially a school museum and research center for the timelines of life, which is revisited frequently by students. Indeed, there is a lot exchange of information between groups.

The Question

The teacher brings children into the wonderful story of space and time, making them curious, and, as a result, they ask a lot of questions. One of our resources comes from educator Maria Montessori, who developed an ingenious process to analyze sentence structure (Figure 3) (Montessori, 1870-1952). It is however, also

Figure 3: Material for sentence analysis from Maria Montessori.



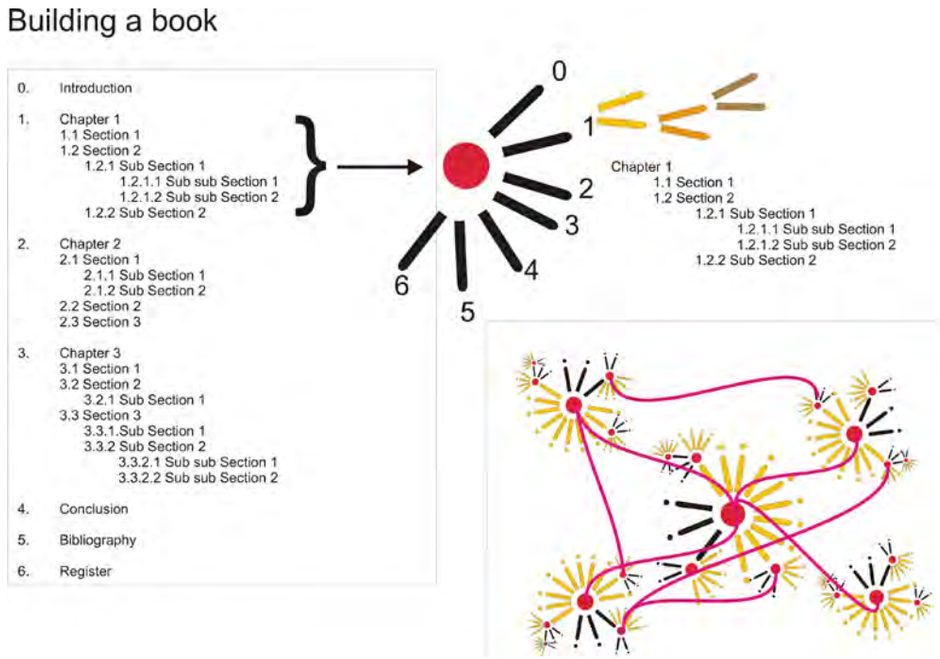


Figure 4: Structure of a textbook compared with the structure of sentence analysis.

possible to use her technique in reverse: To make language. Every child has his or her own questions, so the teacher helps them develop at their own level towards graduation. This process helps the child organize questions and construct a format for their work, similar to a university dissertation, but at a more basic level. (Figure 4).

Ultimately, the work of the child in our program takes on the structure shown in the bottom right image, where the pink lines show the relationship between various sub-topics. The material from sentence analysis is extremely stimulating for the child's research. It introduces a very important value, in contrast to the traditional rote style of only answering questions about standard material from a book.

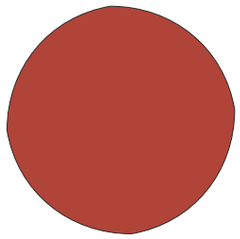
Repeating Patterns

As a result of combining the "Powers of Ten" and the "Lines of Life" and the "Material for Sentence Analysis", a teacher can use easily understandable and transferable frameworks to study our complex Cosmos as a whole. No matter how complex elements of our universe are or how deeply we zoom-in on the smallest details, we are never lost and never lose sight of the whole.

But there is even more that we gratefully use in education!

When we are questioning space and time, the repetition of patterns supports a child in establishing their relationship with the world. It is not a coincidence that we find repeating patterns in human language that are similar to patterns in the Cosmos. If we study space and time with children, we see one thing all the time: There is always "development": "To develop" is – in linguistic terms – a verb and, in reality, it's an activity or energy. How about the origin of everything, the Big Bang? What an activity! What an energy! With the material for sentence analysis of Maria Montessori we can make a linguistic representation.

The linguistic representation of a predicate is:
As time progresses, a subject is created from matter. The linguistic representation of the subject is:



And then there is meaning!

There is a linguistic sentence formed by a subject and a verb. There is meaning, what we humans see as the connection of energy and matter. (In Dutch we have the same word for "meaning" and "sentence" = *zin*, which makes this comparison more beautiful!).

Wherever we look in the Cosmos, there is always the beginning of something. In the physical universe, this often occurs under the influence of gravity, while it takes place through attraction forces in the living universe. The interaction of these things and forces lead to "something new" being created all the time.

As humans, we can duplicate this process of creation in space and time, and then express it in language. Figure 5 can be seen as a highly simplified picture of this evolution in space and time, where the great light red circle represents the Cosmos that repeats itself.

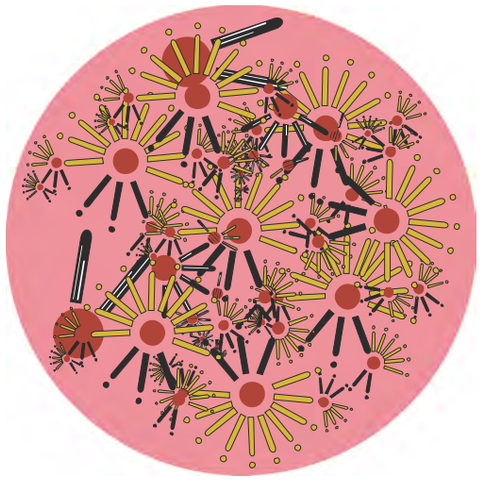


Figure 5: Simple representation of the recurrence of development in space and time.

The prepared environment

The teacher takes the child into a grand and universal story, helping to guide them through their developing relationship with the world by encouraging them to look at and to understand space and time. They provide a rich environment for the children, including

books, maps, charts, illustrations, selections from the Internet, movies, art and other source materials. This "prepared environment" for teaching, research and study encourages children to do their own investigations and find answers on their own (Figure 6). The teacher prepares utilizes four key planning principles, which constantly interact with each other:

1. The cosmic order, which fits with overall time and space;
2. The social order, consistent with conditions and covenants in our society;
3. The biological order, consistent with the biological development of children;
4. The personal order which suits the individual child.

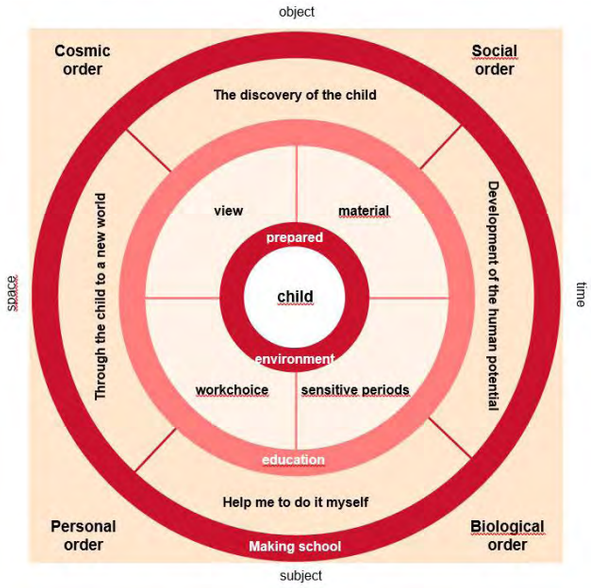


Figure 6: The prepared environment with the starting points of Maria Montessori. (Poorthuis, 2009)

The portfolio

The teacher follows the child's development and helps them to create a "masterpiece" for each subject. This masterpiece is an embodiment of the child's thinking about a given topic. It illustrates what the child has learned in a beautiful way, and justifies the work to the teacher and their fellow students. During their time in school, each masterpiece is saved in a portfolio. The portfolio embodies the child's pride in achievement; it is a collection in which their development is visible through images, language and in every way that the child wants to express themself, both physical and digital. This could include a "dance of the Big Bang", for which a movie is made. It is not about comparing, but serves to represent what the child has made on their own, showing what they have come up against and how it has been resolved. It therefore represents the child's own strengths. The kids present their portfolios to each other, and so get a chance to see that everyone has made something different, something characteristic of their own selves.

Making school

I described earlier how, when we make the journey through space and time, all learning appears to be "natural". Using the "making language" tool, as shown in Figure 5, it is not difficult to make choices among essences (the smaller red circles). If we look in this way at the *Line of Everything*, without even pretending to be exhaustive, we see things that are normally not integrated into or even offered in traditional primary education:

- The Big Bang;
- Gravity, the binding force of the cosmos;
- Matter;
- Aggregation states of matter;
- Formation of galaxies;
- Life cycle of stars;
- Our solar system as a product of a second generation star;
- Geological processes on earth;

In the same way, we meet such essential development if we inventory the other timelines or when we investigate the journey through space with Kees Boeke. With the help of the structure of our language, which follows repetitive patterns of the Cosmos, it's pretty simple to identify and to select basic curriculum for basic education, as well as to offer it in an integrated and narrative format. For the child, such an integrated presentation in story form is a very logical approach.

A teacher can have confidence that the repeating patterns, which they had previously encountered in the *Lines of Everything*, will appear in the other Lines. For example, in the *Line of Life*, this appears as:

- The *Line of Humans* shows human self-awareness;
- The *Line of Culture* shows the results of human self-awareness;
- The *Line of Myself* shows the individual child as a repeating pattern of the Cosmos, with strength, self-awareness and a capacity for planning, research and building.

The child gets the opportunity to develop their own individual potential through a free choice of work within a well-prepared environment, in which the teacher is the guide for them to "do it by yourself". And "appearance" is always surprising!

Now, from the point of view of a teacher, we get a number of important points that to consider:

- The holistic structure of the topical frameworks, along with repeating patterns, gives the teacher and children a chance to comfortably contemplate things within the complexity of everything;
- The teacher and child learn how to deal with new situations in later stages by having learned from previous situations;
- Studied choices reinforce the teacher and the child in making new choices;
- The teacher and the child will never lose their way;
- For the teacher and the child, it is pleasant to find out that they cannot know everything, but – at the same time – they have an overview of what they don't yet know, and this consciousness can be very stimulating for their later studies.

I see the investigation of relationships and connections that occur in our universe to be the main task of good teaching. They can give us answers to all questions. It is important that school is therefore open to the Cosmos as a whole, as one great whole that we are part of. It is not for others to place any fence that can separate us from other knowledge. Everyday we consider the knowledge of today, the things that really matter: Everything is there and everything should be there too so we can make our choices. No one should put on the brakes! Without limiting in advance, humans have a greater chance to find answers for tomorrow. Thus we can arrive "through the child to a new world"!! (Montessori, 1953)

Finally

The remarkable thing is that the teacher tells a universal story and that story will be different with every teacher, but uniform and universal. It requires the teacher to be very careful. The teacher does not have to know all the answers – s/he knows the ways to find an answer! And the child is not questioning the teacher, but questions time and space. There is room for the teacher to tell about "not knowing" things. The point is obvious that a teacher does not know everything and that s/he is searching too. Answers are examples. The teacher has set an example for the child. S/he is also an example of working together. If you work together, everyone can gain new knowledge and together know even more!

In this context, I like to share some quotes from two of my sources of inspiration.

> *Let us give the child a vision of the entire universe. The universe is a reality and an impressive answer to all questions. We will investigate the path of life together, but all things are part of the universe, all are linked together into a comprehensive unit. This image helps the mind of the child to focus, to stop wandering around in an aimless quest for knowledge. It is satisfied, it has the universal center of himself and all things found. It is essential to address the interest of the child at a center point. The methods commonly used today, are not effective. How is it possible that the spirit of a young person stays active and interested as all of us remain engaged in teaching a particular subject with a limited scope and limited to the transfer of knowledge with those little details that he is able to learn by heart? How can we force the child to be interested as interest can come only from within? Only obligation and fatigue may be induced from the outside, never interest! Let this be very clear.*
>
> —Maria Montessori (Montessori, 1947)

In fact, we can imagine the best the pattern that connects as a dance of interacting parts.

And a powerful thought that he formulated in a letter complaining about the shortcomings of Western education:

> *Break the pattern that connects the curriculum and inevitably you destroy all quality.*
>
> —Gregory Bateson (Bateson, 1979)

Thinking about the last words of Gregory Bateson, I dare to say from experience that, especially since the time of writing forty years ago, still not much has changed in education. Bateson calls this stagnation a "contagion of teachers". Great thinkers of the past have stimulated me, often in opposition to the uncomprehending or indifferent attitude of my own colleagues. Their statements read like poetry: (Weate and Lawman, 1998)

- Socrates (469–399 BCE): "Ignorance is the only evil".
- Aristotle (384–322 BCE): "There is something wonderful in all natural things".
- Descartes (1596–1650 CE): "I think, therefore I am".
- Spinoza (1632–1677 CE): "Joy can never be too much".
- Kant (1724–1804 CE): "Two things fill my mind with ever increasing admiration and awe, the starry heavens above me and the moral law within me".
- Wittgenstein (1889–1951 CE): "The limits of my language are the limits of my world".
- Sartre (1905–1980 CE): "A man makes himself".
- Maria Montessori (1870–1952 CE): "Help me to do it by myself".

The (still very conservative) acceptance of Big History in the scientific world and the establishment of the International Association Big History is encouraging. It gives me extra motivation to promote Big History and Cosmic education as a liberating and potentially very strong alternative in education.

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Jos Werkhoven was born in Amsterdam in 1950. For thirty years (1972 to 2002), he was a Montessori teacher, director, trainer, supervisor and developer of educational materials. Since 1995, he has run his own publishing house, from which he publishes educational material in the spirit of Dr. Maria Montessori. Besides publishing, Jos is still very busy with the development of new educational material. He works together with a lot of Montessori professionals to renew material for mathematics for primary education. And, with other professionals, he is renewing material for language for primary education. The next step is be to publish a book of his ideas about modern education, inspired by Dr. Montessori. At the same time, there will be work on a new material of the Lines of Life. He still teaches and supervises Montessori teachers or is present with lectures on congresses or parent evenings at primary Montessori schools. His aim is the enhancement of "cosmic education" (the name of Big History in Montessori education).

Cosmic education in the First Dutch Montessori School in The Hague

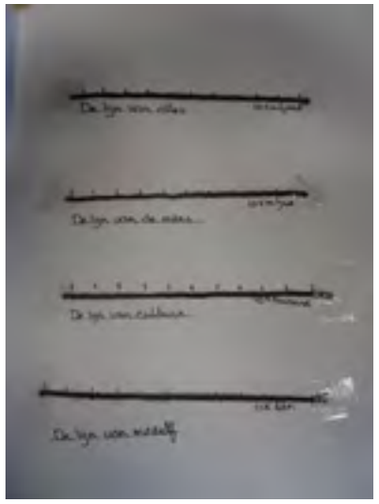
class taught by Nicoline van Ginkel

Children listen to the teachers story and roll along the ribbon of time. They experience how long it is and the best part was what the boy was sitting by the red piece at the end.
He was the only who had 'something else'. He stood at the end representing the present, the time from which he already knew something.

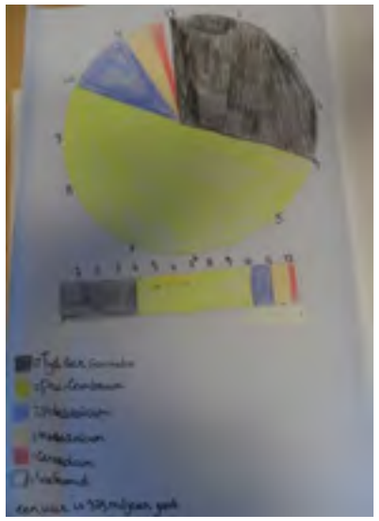
In the pictures you can see many different processing forms. Sometimes the children invent their own, sometimes the methods themselves. The different processing forms lead to discussions about various skills. Some children work together to design, draw, and fold a box or pyramid.

The homemade book 'From nothing until now', the children made after telling the narration with the black ribbon (Montessori material).

The book 'From nothing until now' expanded: all stages of the developments are shown.

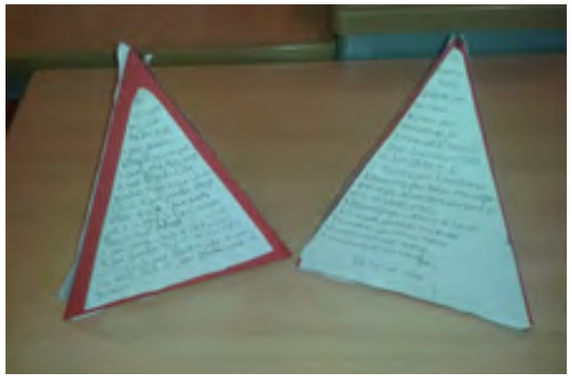


The timelines of everything, human, culture and child.



The circle indicates the time of formation of the precambrian, the paleozoic, the mesozoic, the cenozoic and the neozoïcum.

The small colored pyramids are covered with pictures.



The great pyramid has four faces; the history is written of the timeline of everything, the timeline of human, the timeline of culture and the timeline of child.

On the last page you will see a world map. Here is the origin of man declared; where they lived and what they looked like.

The book 'From nothing until now', unfolded on the ground.
Children walk past it and tell what they see.

Planets work of a girl made by self-made wax sticks. In the white paper she wrote what she did; she also wrote information on the planets.

A booklet in a box on the evolutionary theory of Darwin. Pictures clarify the text.

A booklet in a box about the whale. An information booklet with text and drawings which is hidden in a pretty self-folded box.

The very beginning of the earth, water and land.
The first animals that live in the water.

The work of a girl about the formation of the Earth.

Children listen to the story that goes with the black ribbon of time. The animals are put down when the teacher tells about it.
So they see evolution from animal to human.