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Montessori Approach to Science Education: Cosmic Vision as a Unique Area of Pupils' Studies

Montessoriańskie podejście do poznawania środowiska społeczno-przyrodniczego. Kosmiczna edukacja jako wyjątkowy obszar uczniowskiego poznania

KEYWORDS

Maria Montessori, Montessori pedagogy, Cosmic Education, Science Education

ABSTRACT

The paper aims at recalling Maria Montessori's essential assumptions about the child development and organization of the educational process as a basic issue considering the concept of science education. In the Montessori pedagogy, it is characterized by the form of the so-called Cosmic Education. Cosmic Education is a unique approach to work with children aged 6 to 12. Thus, the idea of Cosmic Education, the relationship between the child's needs and the science education curriculum is elucidated. The essence of the Great and Key Lessons as centers of children's exploration and research is discussed. The Montessorian way of learning about fundamental human needs is presented as an inspiration for school practice. The basis for collecting empirical material is the analysis of the content aiming at the current achievements within the selected topic characterization.

SŁOWA KLUCZE

Maria Montessori, pedagogika Montessori, kosmiczna edukacja, poznawanie środowiska społeczno-przyrodniczego

ABSTRAKT

Celem niniejszego artykułu jest przypomnienie głównych założeń, jakie sformułowała Maria Montessori na temat rozwoju dziecka i organizacji procesu edukacyjnego, jako punktów krytycznych w rozważaniach nad koncepcją kształcenia w zakresie poznawania środowiska społeczno-przyrodniczego. W pedagogice Montessori wskazana koncepcja przybiera postać tzw. Kosmicznej Edukacji. Kosmiczna Edukacja jest unikatowym podejściem w pracy z dziećmi w wieku od 6 do 12 lat. W artykule wyjaśniono ideę Edukacji Kosmicznej, wskazano związek między potrzebami dziecka a programem poznawania środowiska społeczno-przyrodniczego. Opisano istotę Wielkich i Kluczowych Lekcji, jako ośrodków dziecięcych badań i dociekań. Zaprezentowano także rekomendowany przez Montessori sposób poznawania przez dzieci fundamentalnych potrzeb człowieka, będący inspiracją dla praktyki szkolnej. Podstawą do zebrania materiału empirycznego była analiza treści przeprowadzona w celu scharakteryzowania aktualnych osiągnięć w ramach wybranego tematu.

Introduction

Albert Einstein defined education as a type of human intellectual activity, the task of which is to establish the fullest possible interdependencies between the phenomena taking place in the world around man which are available to the senses (Butryn 2011: 352). The process of establishing combinations and dependencies takes place through systematic and planned thinking. That is why, paraphrasing Einstein, first of all, man should acquire the ability to think critically and independently and attain general intellectual and practical skills. These skills are much more important than specialist subject knowledge which is not capable of meeting needs emerging in the diverse and complicated conditions of human life (Butryn 2011: 350). According to Einstein, the essence of education is not to acquire factual knowledge but, firstly, to exercise the mind so that it is able to seek and build knowledge independently and, secondly, to foster the belief that study is not a duty but "an enviable opportunity to learn to know the liberating influence of beauty in the realm of the spirit" (Einstein as cited in Butryn 2011: 350).

This objective of the paper is to recall Montessori's assumptions about the child's development and organization of the educational process as a crucial issue considering the concept of science education. The basis for collecting empirical material is the analysis of the content aiming at the current achievements within the selected topic characterization. The critical content analysis leads to systematic and reliable indication of what topics were mentioned and how they were discussed in the collected

research material (Szczepaniak 2012: 84–86). It is widely accepted that the purpose of the method of analysis and criticism of the text content is primarily the characteristics of the current achievements within the selected thematic area. This is accompanied by the components of interpretation and conceptualization. The researcher's conduct is guided by the methodological rules related to the need to ensure the efficiency, credibility and cognitive value of work results (Cisek 2010: 277–280).

Organization of Children's Education for the Development of Independent Thinking Skills

Maria Montessori developed an original concept of child education based on the search for replies to fundamental questions about the sense of life and human growth. The idea developed from the understanding of human nature enabled Montessori to work out an original concept of school and education. At the beginning of the 20th century she elaborated the universal laws governing the development of children. That resulted in the preparation of a school environment that would correspond to the disclosed needs of a child (Bednarczuk 2016: 9). Montessori stated that education can be used as a kind of help for a child in developing his individual life potential and gaining independence. The source of the child's independence becomes his or her spontaneous activity which results in his or her specific developmental achievements. This should be stimulated and controlled by the school environment, the so-called p r e p a r e d e n v i r o n m e n t. According to Montessori, activity and independence are inseparably connected and the sentence: "Help me do it myself" illustrates their relations perfectly. Thus, freedom proves to be the basic condition of the mental set transformation. This is freedom to choose where, when, how long and with whom the child would like to work, learn or play. Nico van Ewijk states "Education of this type has been a piece of research, a scientific experiment to investigate the possibilities inherent in the scholar, and to offer him means, stimuli, which might awaken what energy was left to him and employ it in permanent fashion, augmenting it with and coordinating it by individual exercises" (Van Ewijk 2014: 49).

At the beginning of the children developmental path, they explore the world through their senses. They are sensual explorers, so primarily they need sensory and manipulative materials, practical life exercises suitable for multi-sensory cognition. Practical life exercises facilitate the development and improvement of small motor skills. Their repetition supports building harmony and coordination of movements. They develop a sense of responsibility for a workplace shared with others. Sensory materials were designed in such a way that children can advance their physical perception and acquire the skills of organizing information. Working with hands-on

materials designed by Montessori supports building universal mental strategies (e.g., ordering, classification, defining categories, etc.) and guides how to control the correctness of task performance. In this way, a set of materials as well as a set of examined and effective rules of behavior in the school environment induce individual work and cooperation (Bednarczuk 2016: 148–149). Teamwork comes naturally in the cases when it is suitable or necessary. At the same time, the child must learn to make use of the potential he possesses: "To get stronger by himself before he can join the group because the stronger the child is, the more he can get involved and the better he can integrate with the group" (Dattke 2009: 102). Thus, education primarily means providing care and love, supporting the development of the organism, its well-being and safety, fostering health as well as moral development (Kunowski 2000: 254).

Then the time comes when children begin to acquire and organize knowledge about the world consciously. The period between 6 and 12 years of age is a time of mental acuity, moral sensitivity and a period of social interests' development. Due to the discussed characteristics, children go to the outside world, "beyond" their inner world, they open up to reality and people. They want to know more, show extraordinary willingness to learn; that is why they seem to be constantly interested: what, where, why, how? Hence this is the so-called "period of special sensitivity" for culture (Montessori 1989a, 1992). Children aged 6 to 9 penetrate their surroundings, get to know social reality available for them (their own social group) in order to understand the principles of its functioning, they are more interested in the world of things than in the world of ideas and concepts. Their orientation in reality is based on the direct action, the contact with objects the child gets to know. The 9- to 12-year-old children become the explorers of reality because this is a period of transition from the specific mental representations to abstract thinking. The reversibility of mental processes is the most essential achievement associated with the form of specific thinking which contributes greatly to the development of flexible thinking, being an important step in gaining independence from objects manipulation (Rękosiewicz, Jankowski 2014: 33).

They become critical explorers; therefore, the learning environment responds to the need for independent cognitive activity implementing qualitatively diverse developmental materials (academic materials). In this stage there is nothing more fascinating for the child than discovering the world. Thus, educational materials should enable studies in diverse areas of culture and stimulate all paths of learning, including the expressive strategy highlighted by Montessori. The student has the opportunity to discover or to explore the content hidden in the Montessori materials. The curriculum integrates the idea of cosmic education. This is an area of the program characterized by the principles of coexistence and interdependence in the material world. This unique approach supports students in constructing their knowledge by focusing on finding the answer to the question about their place in the world

(Bednarczuk 2016: 149–149). In this case education is formation of subjective consciousness of the pupil while learning about reality (Kunowski 2000: 254).

The Idea of Cosmic Education

The term *cosmos* is of Greek origin and means order, the world in the form of the harmoniously organized whole, the reverse of chaos (Kopaliński 2003: 279). The concept of Cosmic Education used in the Montessori pedagogy refers to such organization of studying the world by the child that he or she can discover the order of the surrounding world, its universal plan consisting, according to Montessori, in the fact that all elements of animated and unanimated nature are combined. Cosmic Education is an educational philosophy which supports Montessori's beliefs about interrelations in the Universe, joint responsibility, cooperation and stability of all the inhabitants. "Cosmic tasks" attributed to being are results of their mutual relations. The cosmic task consists in doing the attributed work by each being to satisfy their own needs, which at the same time creates the conditions for the development of others and thus the world. "But there is a purpose more important than the protection of the offspring or the preservation of the species. It is somewhat beyond mere growing according to a pattern or living according to instincts. This more significant purpose is to conform to a master plan towards which all things are moving" (Montessori 1989b: 2) The example given by Montessori was a mollusk. It takes calcium carbonate from the sea to build a protective coating building its own house, but at the same time the amount of this substance diminishes in the sea-water. If its level was high, the life on Earth would be poisoned (Montessori 1989a).

The task set for the man depends on the place of his dwelling in the course of his or her life. The child's task is creation of a person, constructing of a man "who will build peace, a man who is adapted to the world in which he lives. (…) the greatest work ever accomplished during any lifetime is that which takes the human being from the helpless state of the newborn baby to the child who, not only manifests the characteristics of the species, but clearly belongs to his own human group and is also his own and individual self" (Grazzini 2013: 111). In turn, the adult gifted with free will and intelligence is to perform a great task of Earth transformation and accomplish the function of transforming nature. He builds culture "to construct a new world full of marvels which surpasses and overrules the wonders of nature. This is a man who creates civilization. This work is unlimited and it is the aim of his physical limbs" (Montessori 1989a: 69). The adult's cosmic task is one of those "contributing to the upkeep and development of the Earth, of creation, modifying and transforming the environment." Building the civilization "which is in *constant evolution* and which *involves* a *continual modification* and *enrichment* of *their* spiritual territory (Grazzini 2013: 111).

The first assumption of the Cosmic Education is helping pupils to discover and understand the laws of the Universe treated, as already mentioned, as a network of relations. Secondly, it includes the support in recognition of one's own cosmic task as the species and individual. "It is only against the background of our place in the universe, our relationship to other living organisms, and our understanding of human unity within cultural diversity, that we can attempt to answer the question 'who am I?'" (Duffy, Duffy 2002: 6). To do this, the broad interpretative context is necessary. Getting to know the Universe includes many issues. It combines the knowledge of biology, botany, zoology and history contents as well as those of mineralogy, astronomy, geography, geology, chemistry and physics. These fields of study are given names but not divided into separated subjects. Each of them develops the interest in the world which is a unity. Each of them reveals facts and phenomena as a part of the common whole (Bednarczuk 2007: 31; Healy Walls 2008: 41–49). "When a child learns about trees, the teacher should not forget to tell how conditions as well as vegetation and animals affects their growth. On the other hand, trees should create such conditions that provide comfortable life for plants, animals and people" (Stein 2003: 133–134). Starting with the whole is aimed at creating representation of cosmic order. Cosmic education is also a way to visualize the social code of "giving and taking," a life and educational philosophy—a close relationship between man and the environment which is developed towards environmental education, education for peace, sustainable education (Bednarczuk 2007: 31; Healy Walls 2008: 41–49).

The Child's Needs and the Cosmic Education Curriculum

Cosmic Education is a unique area of learning developed by Montessori as a tool for educating particularly 6- to 12-year-old children. She defines that period of life as "the time of culture" during which the human spirit is organized. However, the contents of the area under consideration appear as early as in the kindergarten. Grazzini (2013: 112) states that "Cosmic Education helps the children to acquire a cosmic vision of the world, a vision of the unity and finality of the world, a vision which gives a sense of meaning and purpose. Cosmic Education gives the children the opportunity and the freedom to explore, study, and acquire knowledge of the universe not only in its globality, but also in its complexity." Individual and team studies support the development of potential of the child (Montessori 1989a). Children learn to appreciate how various cosmic forces work and interact. They discover nature of scientific laws.

As early as in the first period of development (0–6 years) a child is brought into the world of nature through experiencing it and working with sensory material. Experiencing nature leads to improvement of the senses. Sensory cognition is a source of

processing and understanding the world accessible to a child at that time. In the course of her London lectures Montessori (2015) pointed out to the importance of elementary materials in the context of indirect preparation for Cosmic Education. Absorbed image impressions and experiencing structures organized owing to the manual activity ("seeing with the hand") are the foundation for "constructing the power of imagination" (Montessori 2015: lecture 5). The curriculum for 0- to 6-year-old children, bringing into the cosmic plan, is very detailed and carefully prepared (Montessori 2015; Elsner 2003). Among the original materials intended for manipulation there are botanical and zoological cards as well as aids in the field of physical geography.

The Cosmic Education curriculum for the 6- to 12-year-old children is different, which results from different developmental regularities. Children are interested in what is unusual, in the things that constitute a cognitive challenge. Therefore, the idea of presenting the vision of the universe corresponds to the child's needs. It satisfies the hunger for knowledge; it is a breeding ground for natural curiosity and emerging interests. It enables the child to search for an answer to the question: who am I?

The children aged 6–12 reach a new standard of moral development. In this period moral principles are still external and the source of motivation to adhere to them are the closest people. However, the child is able to observe accurately what behaviors are socially acceptable in his or her school group, in the family and in the peer group. He/she becomes convinced that what is good is that what is recognized as good by the family, class, group of friends. Considering morality from the perspective of the social system, the child sees the sense of preserving it. He or she becomes aware that the needs of the individual are not more important than those of the entire social group (Rękosiewicz, Jankowski 2014: 29). From the perspective of socio-moral development, Cosmic Education patterns, models, ideas for children looking for moral awareness through stories about the universe, heroes, rulers, significant figures (Healy Walls 2008; Helfrich 2011: 42).

Children are interested in establishing various social relationships. They begin to become gradually independent of their loved ones and are able to participate in a wider social context. They meet the world of a new class where they meet students from different age groups (mixed-age group) which results in increasing the number of contacts and acquiring new social skills. They learn and master the principles and rules of teamwork being able to follow new rules. Children work willingly in a group, derive joy and satisfaction from the opportunity to learn with others so Cosmic Education is a study of shared responsibility and cooperation. It enables learning in cooperation, in mutual relationships/interactions, both in the classroom and outside it.

Cosmic Education meets one more characteristic of the child's developing potential. The explosion of imagination characterizing the 6- to 12-year-old children provides the opportunities of obtaining information and motivates them to learn. Owing

to their imagination children can come into contact with the content that they are not able to experience directly. This is how imagination "enables us to see those things that are in front of our eyes" (Montessori 2015: 173). The power of imagination and the emerging ability to abstract mean that there are no limits to the children's search—the universe itself is the limit. Therefore, Montessori wrote (1989a) that we should give children a vision of the Universe because by presenting it we can help the child with learning and organizing knowledge processes.

The frequently repeated phrase—"the vision of the Universe"—is the distinguishing feature of the Cosmic Education curriculum. Strictly speaking, this is not an educational curriculum in the sense of the traditional scope and sequence. This is rather a holistic, inviolable, inseparable and rich-in-detail set of stories about the formation of the universe, the solar system, the Earth, life on earth and human inventions that inspire students to seek, deduce, argue, explain, reason logically, investigate and build knowledge. Getting familiar with such complex issues is possible due to exploration. The child gains an understanding of the world through experience and exploration. As Charlotte Poussin, Hadrien Roche and Nadia Hamidi (2019: 63) state, children notice that the more they delve into a given topic, the more they can see and understand. Presenting the universe as a dynamic creation, in which all its elements have a task to do, encourages children to contribute to its development. "Montessori looks at the world, sees the world on a very grand scale, that is, at the level of the universe with all of its interrelationships. There is the inorganic world which is ecologically linked in innumerable ways with the biosphere which, in turn, is linked with human beings or the psycho-sphere" (Grazzini 2013: 108). Montessori offered students a vast panorama of the history of the universe and mankind in the form of six Great Lessons, accompanied by more detailed Key Lessons (Lillard 1996).

Great Lessons as a Center for Children's Research

In the Montessorian approach the child is supposed to learn and explore the laws of nature, human achievements resulting from understanding the idea of working for the common good, from noticing the knots of interdependence. Discovery of the laws of the Universe proceeds from general to the detailed being based on the analysis, observation and reflection on the content of the Great Lessons.

1. The First Great Lesson is the History of the Universe. The story of how the world, the sun, the stars, the moon, the earth and water, etc. were formed. It presents the world at the dawn of time, characterized by earthquakes and volcanic eruptions. The slow shaping of the earth's crust took place in response to the natural laws of nature. "The Sun (the prime source of energy), the Land

(also the rocks and the earth or soil), the Water and the Air, all of which act and 'work' according to the cosmic laws of their being, that is, according to their inherent nature" (Grazzini 2013: 109). The story of creation, the bringing into being of what did not exist before, this is one aspect of cosmic education and then there is, as it were, the "house-keeping" or maintenance of that creation (Hayes 2005: 3).

2. The Second Great Lesson is about Coming of Life, about how life appeared in the sea and spread over land. This is the tale of various cosmic tasks of living beings. "We see how Life appears to save and preserve the order and harmony of the world since, left to themselves, the non-living agents cannot maintain cosmic order and threaten to bring about chaos" (Grazzini 2013: 110).
3. The Third Great Lesson: In Coming of Humans child gets to know the evolution of a man, starting with *homo erectus* and *homo habilis*, going to *homo sapiens*.
4. The Fourth one—The Story of Writing—presents the human need to communicate with the help of signs and methods improving communication tools.
5. The Fifth Great Lesson—The Story of Numbers—introduces students into the world of simple signs and counting on bones and sticks, to Roman numerals and the introduction of zero.
6. There is also the Sixth Lesson, called the River of Life, devoted to the work of the human body (Lillard 1996; Duffy, Duffy 2002; Healy Walls 2008; Poussin, Roche, Hamidi 2019; Clarkson, Clarkson 2009).

The goal of each lesson is to wake up the children's astonishment so that they are inspired to continue searching, asking questions, and investigating. Lessons are not designed to teach facts presented in the story. Story and study are the essence of the Great Lessons (Duffy, Duffy 2002: 34).

Storytelling is an indispensable element of Cosmic Education. "Events, reflections, results, facts, hypotheses, research, natural disasters, mysteries of nature and everything that can be experienced are told in their own words here" (Elsner 2003: 2). This is how students are inspired to carry out research and make projects. Therefore, it is essential for the story, as Healy Walls writes (2008: 52–53), to follow a few basic principles. Firstly, the story must be presented in an inspiring way. Secondly, it must start with philosophical notions hidden behind the cosmic plan. Thirdly, the indicated theoretical and logical approach must be presented in an appropriate scientific language, adjusted to the child's interest and mental possibilities. Fourthly, all presented information should be correct and sufficient as a starting point for their own scientific research. Finally, the story should specify the means by which the child can continue researching the data.

As Lillard (1996: 71) emphasizes, in the days after the Great Lesson, the teacher's goal is to get groups of children to search for the answers to their questions as well to provide studies and do their work together. The Great Lesson alone cannot accomplish this aim. Its purpose is to indicate the general area of study. Key Lessons make the exploration possible because they provide additional and detailed information in a particular field. The key lessons are not given to every child or in any particular time frame. The teacher chooses lessons on the basis of the observation of the child's interests (Lillard 1996: 71–72). To paraphrase Montessori's words: "One plan and many patterns" (Montessori 1989b: 82).

In this way, the Cosmic Education curriculum goes beyond the limits of linear and systematic acquisition of knowledge, for example successive representatives of the plant and animal kingdoms, in isolation from the broad cognitive context. The Montessori curriculum includes monumental stories about the origin and evolution of life on Earth, which stimulate children to undertake individual or group thematic studies. Therefore, if in the first period of development (0–6 years) the Montessorian materials evoke deliberate and orderly activities of the child, they constitute the scaffolding of children development and in the mid-school age the materials become of secondary importance. It is essential that the child should build the context (the whole) of systemic thinking necessary to understand himself and his place in the universe. The interests generated by the Great Lesson become the most important. The materials available in the classroom have to maintain children's curiosity and enable research (Duffy, Duffy 2002; Healy Walls 2008; Poussin, Roche, Hamidi 2019). This provides a structure within which the inspiration will stay alive and grow into further learning (Healy Walls 2008: 53). It is important that children should have time to accomplish their projects. This is a huge challenge for the teacher. The curriculum is created bottom-up. This means that it is inspired by the child, so it is born in action. Clare Healy Walls recommends that "it is preferable to inspire the children to plan for themselves by presenting them with the wider curriculum that they must cover, helping them to understand gradually all the existing topics that must be covered over the next month/year. This encourages them to seek lessons and inspiration on topics as they develop responsibility for managing their own curriculum" (Healy Walls 2008: 47). In this way recognizing children's interest areas is a source of the curriculum.

Great Lessons provide children with the opportunity to examine the outside world carefully. They develop, perform and present their own or group projects. The teacher guides the child to make contact with experts and sources of knowledge that help further research and creation. Children are set free to explore and establish their own paths through the complex maze of knowledge on the Earth. They discover many kinds of interrelationships existing in the world and thus explaining how the Earth functions (Grazzini 2013; Stephenson 2015).

In summary, Cosmic Education encourages the child at an early school age to learn about the natural laws of the world of nature, interdependencies and mutual links between organisms and basic needs shared by all people via stories, presentations and experiments. Thus, we are approaching the Montessori concept of history. In order to develop the concept of history, it is necessary to examine different ways in which people meet their needs.

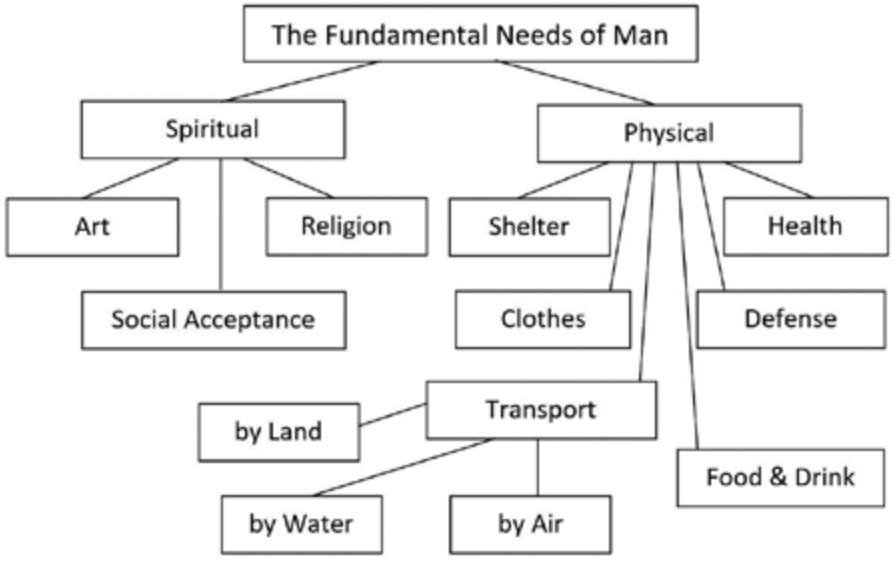
Fundamental Human Needs as an Area of the Child's Investigation

The Third Great Lesson, the Coming of Man is accompanied by Key Lessons concerning fundamental human needs (Lillard 1996: 72). Children start to learn about fundamental human needs at about the age of six and continue throughout the period of education. Children talk about the needs and about satisfying their own needs, about how they are satisfied by people living today in the civilizations and cultures they have learned about (the scope of knowledge depends on the age of the students). This is a key to the history for the children as well as the "concept" of history (Hayes 2005: 7). The Montessorian approach to history focuses on the search for an answer to the question: How do people satisfy their needs? Montessori was fascinated by the fact that significant progress of civilization was connected with changing ways to satisfy the universal needs of people (Poussin, Roche, Hamidi 2019: 177).

The Fundamental Needs of People develop the paradigm that all people share the same needs and the only difference between various groups of humans is how they satisfy those needs. The differences are representative of geographical location, time period and social economic status. Therefore, humanity "is more alike than different" (Cunningham 2017). How is this topic presented to children? Marianne and John Clarkson (2009) propose a special Key Lesson about a boy living in Stone Age who strayed from the tribal group, got lost and had to look for shelter, food, clothes, satisfy the need for security. He missed his family and expressed his emotions by means of free expression. In the intention of the authors this story is to initiate children's studies on fundamental human needs: "Og looked up. The sun was going down and it was starting to get dark. (…) I need somewhere to shelter for the night. (…) He could not sleep; he was so thirsty. He found an icicle dripping. He made a cup with his hands, and drank. (…) He heard the noise. The noise seemed to be coming closer. (…) He tied the flint to the top of the stick with a piece of skin from the bear. Now Og had something to defend or protect himself with. Og prayed to the Great Spirit of his tribe (religion)" (Clarkson, Clarkson 2009: 63–64). It is worth comparing Og's needs and the way of meeting them with the needs of contemporary children. According to

the classic Montessori methodology, children are proposed a discussion on what they would do if they were on a desert island and had to survive on it (Duffy, Duffy 2002; Motz 2001), or a conversation referring to their everyday life, for example about the clothes in which they came to school, about the means of transport they have taken to get to school, about what they have eaten for breakfast, about the appearance of their homes, spending free time in the museum or cinema (Poussin, Roche, Hamidi 2019: 188). It makes them discover fundamental needs of all people (Fig. 1): physical ones (nutrition, clothes, shelter, defense and transport) and spiritual (art and religion).

Fig. 1. Fundamental needs of people



Source: Clarkson, Clarkson (2009: 75).

Learning history leads to discovering and finding different ways of meeting the needs of man across time and space. Across time means finding out how humans have met each fundamental need across time. Children can also examine how people satisfied their needs in a chosen period and in different cultures living at one point in history (satisfying needs in a particular place).

The following exercises (based on Motz 2001; Duffy, Duffy 2002; Poussin, Roche, Hamidi 2019—materials copied for the internal use of members of the Polish Montessori Association) can be used as an introduction into the studies on history:

(1) Our needs

M a t e r i a l s: a set of empty circles with a diameter of at least 10 cm, a marker, two labels: spiritual needs, physical needs.

P r e s e n t a t i o n: *Look around you. There is a great variety of beautiful things at our disposal. We are satisfied, healthy and not hungry. Think what is the most important in a person's life. Without what could we not live and perform duties? What do we need every day? What are yours and your parents' needs?*

The children give their answers, the teacher writes them down on the prepared circles. He/she tries to stimulate them to identify needs and enumerate as many as possible, arranges the circles in such a way that children can see them. He/she summarizes: *Many of the above-mentioned needs concern our body: food, shelter, clothing. I have labelled them: physical needs. The other needs concern our spirit. These are spiritual needs*.

Students can draw and cut from newspaper illustrations of goods/things needed for life and put them on the circles. Children can also arrange their needs according to the fundamental human needs chart (Fig. 1). It might be interesting for children to analyze one need, such as a shelter, from the beginning of humanity to the present day. In this way the child carries out a vertical history study across the ages and years.

(2) Vertical history study

M a t e r i a l s: a set of cards, a set of labels with names; sets of e.g.: sea, air, land transport, lighting methods, seats, human shelters, history of clothing, history of weapons, history of the car.

P r e s e n t a t i o n: The teacher reviews the selected set with the child and discusses the content of the pictures. The conversation is based on the questions: Which is older, which is more modern, which is simpler, which is more primitive? He/she puts the picture of the oldest object, e.g. a house or a cave on the left side of the child and that picture of a contemporary house on his/her right side. This follows the principle of working with all timelines that past is on the left and present on the right. It is possible to arrange pictures from all sets. It may turn out that there are a few captions from the BC era and a majority of them on the right.

On the other hand, if the child is particularly interested in one historical period and draws up a graph of all needs for that era, he or she will carry out horizontal historical studies. Clarkson and Clarkson (2009: 77) suggest that the next stage of studies would be left until the Fourth Great Lesson when the children are introduced to the Timeline of Civilizations. They will be informed about satisfying the Fundamental Needs in a series of major stages in the children's culture (for example Ice Age, Early Egyptian, Ancient Greek, Roman Empire, Medieval, Modern).

(3) Horizontal history study

Materials: as above.

Presentation: The teacher chooses a period, preferably contemporary to the child, and discusses how people meet their needs. In turn, he/she moves to the periods more distant for the child. An additional advantage of the exercises, apart from recognizing how the ancestors' needs were satisfied, is the possibility of realizing that after crossing a certain stage of development, civilization began to develop very quickly.

The recognition of fundamental human needs structures students' research and is a starting point for further exploration. In this way, children can learn about the cultural and civilization achievements of mankind.

Conclusion

Cosmic Education proves to be something more than the subject of education. This is vital and educational philosophy, originating from Montessori's belief concerning the human close relationship with his/her surrounding and the nature scheme based on the rule of coexistence. It is developed by the Montessorian educators towards ecological education, sustainable development and peace education. Cosmic Education aims at inspiring students, arousing interest and causing delight at the complexity of the Universe vision so that the children would like to learn independently, explore various issues of interest for them thoroughly. If children take up an action for internal reasons, this is probably because this action is important for them. Even if they forget the facts, they will not forget the joy of learning, and the developed information processing strategies will remain a learning tool. Thus, the children are given keys to knowledge and the world. These are the only reasons for which Cosmic Education can be regarded as a unique area of pupils' studies. It is uncommon that the idea of Cosmic Education came into being based on cognitive, social and emotional interpretation of children's needs and the educational curriculum of each child is a result of his/her interests stimulated by teachers' presentations and stories. The uniqueness of the presented area consists also in the fact that it gives the children the opportunity and freedom to explore, study, and develop their knowledge of the universe not only in its globality but also in its complexity (Grazzini 2013: 112). It is worth mentioning that the Montessori cosmic curriculum is focused on the process and issues of science. It emerges from the study of life, the laws and structure of the universe, the coming and evolution of life, the significant discoveries and their consequences for the development of civilization. The methodical approach addresses the pupil's attention to the sense of wonder at the splendor of the Universe, the beauty of the physical laws, the phenomenon of life, and the respect for the efforts and inventions

of forefathers. Searching for other arguments in favor of original character of Cosmic Education based on Grazzini's, one can recall its specific approach to culture. "With this approach, we pass from the whole to the detail; each detail is, or could be, referred to the whole; the whole is made up of ordered parts; and lastly, specialization of knowledge and interdisciplinary character developing simultaneously, integrate and complete one another" (Grazzini 2005: 112)

Thus, the primary goal of Cosmic Education is to encourage pupils to understand science as the process through which humanity has built up its legacy. The process based on asking questions, observing systematically, collecting and analyzing data and controlled experiments. This way Cosmic Education is a preparation for lifelong education.

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