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## The use of constructivist pedagogy in science education

*"Each educational system is based on a particular theory of human mental development. In recent years, we have been observing a renaissance of the constructivist theory of mental development of an individual which says that the individual has an impact on their cognitive development, structuring understanding of the world during their activity"*

*Władysław Puślecki*

Science education should be introduced since childhood and become one of the important missions of the modern school (Cichy, 2002). It is due to the fact that its main goal is shaping high level of awareness, that is, the responsible approach towards the environment. The aim of this education is to teach a new view on the environment and its qualities, and to prepare to undertake proper endeavors for environmental protection and rational use of its resources. Therefore, maybe premises of the constructivist pedagogy that enrich endeavors aiming at shaping environmental awareness are worth using in a wider aspect.

Constructivism is a theory that supports activating approach to teaching. It treats the learning one as an active individual and the teaching one as a guide – a person whose role is to organize a learning environment. It derives from works of J. Piaget, M. Montessori, J. Korczak, J. Dewey, A. Leontiew and L. Wygotski, while J. Bruner developed the theory.

Analyzing the literature, one may conclude that constructivism is a view which postulates that people (actively discovering reality they function in) acquire knowledge while interacting with the surroundings. At the same time, it is a theory of learning, gaining knowledge, and teaching.

According to the aforementioned premises, currently the following methods are being rejected:

- Traditional copying of ready-made patterns,
- Learning set instructions in order to search,
- Modification,
- Interpretation,
- Checking information by the learning one.

According to the constructivist pedagogy, studying means building own knowledge structures by a thinking person, not acquiring prepared contents or patterns. It is because human mind is not a camera that records or reflects reality; it creates knowledge in a form of pictures, concepts, and emotions.

Basing on the neurobiological approach to the way the brain functions, constructivism postulates that:

- We learn by interacting with the surrounding,
- Our knowledge is an individual CONSTRUCTION,
- It is broadened by adding new elements to the elements we already have, according to the rules of assimilation and accommodation (ORKE, 2019).

Representatives of this current claim that people learn through interaction with their surrounding, actively construct their own knowledge by using knowledge they already possess. Effects of cognition depend not only on the maturity level and a system of direct external influences (teaching) but, first of all, on the scale of activity of the learning one. The learning one does not register incoming information as much as they build knowledge structures from available data. That is why it brings a pedagogical postulate for the learning ones to be active and creative, because attempts of passive acquiring of knowledge provided by the teaching one and books will not result in satisfying effects, in terms of both quantity and quality.

Foregoing thoughts on constructivist pedagogy and a role of environment as a content and value carrier may be applied in regard to science education. Considering the fact that the environment teaches and rears, it becomes a perfect "tool" in the educational process as it creates ideal conditions to gain knowledge, to experience and observe various phenomena within it. It applies to formal education at educational establishments as well as to informal education associated with the process of shaping our approaches, values, skills and knowledge, based on various experiences and influence of the surrounding. It has been long since known that that in science education (both descriptive and expository), ability of direct (or indirect) observation, perceptiveness and independent judgment should be at the first place (Niewinowski, 2012).

For more effective teaching in terms of science on every level of education, it is important so that students are allowed to:

- explore their surroundings unassisted,
- use tools designed for this purpose,
- analyze changes in the environment,
- describe and explain phenomena in nature,
- and to predict effects of human activity on the environment.

Those goals can be achieved mostly through field classes where students have a direct contact with nature.

It needs to be kept in mind that learning environment is not limited to educational system but is created also by:

- everything that takes part in constructing new knowledge about the world,
- prior knowledge,
- cognitive style of the learning one,
- relations between the learning one and subject of cognition.

Giving meaning to incoming stimuli always takes place in context of previously possessed information and experiences, because constructing of knowledge requires:

- interpretation,
- re-organization,
- transformation,
- generalization of incoming information.

Constructivism proposes education based on:

- experimenting,
- searching directed by ideas of the learning ones,
- presenting problems interesting to the learning ones,
- creating new models and hypotheses.

At the same time, it is advised to handle everyday life issues, treated holistically, with their level of knowledge and experiences in mind. The role of the teaching one should be only creating convenient opportunities to undertake cognitive activities, and building bridges between shallow understanding and more complex understanding of a problem.

According to Wiktorja Sobczyk (2001), people explore nature through:

- exploring their own personality,
- using imagination and intellectual capabilities,
- boosting creativity,
- respecting nature,
- personal involvement into environmental issues.

Nature teaches us to be humble and guarded in our judgments. As Ryszard Kulik (2003) claims, while observing natural processes, we may get revolted, we may not like something, or we may be amazed, but nature does not care. It is the way it is. Fish swim in the sea, birds fly in the sky, and earthworms tunnel through soil. Everyone and everything has its place and does what it does. Taking part in classes where nature is a teacher, we come to a conclusion that in fact, there is no difference between a student and a teacher. We are a part of nature and fall within the same transition processes as it does.

Nature has been a perfect information and value carrier. It is also still an underestimated educator. When people lived closer to wild nature, deep knowledge about interdependence of all living creatures was the most important. Just like animals, young people were gradually learning how to handle nature around them, because they gained knowledge about other creatures living in the same environment, about their habits and characteristics. Experiencing danger, searching for warm shelter and nutritious food were everyday issues of human existence. Secrets and laws of nature were a part of life. A modern man treats nature as a private factory which can be used to get everything necessary for living without any limits. Focusing on our own needs and expectations, we often forget that each organism has the same right to live as we do, and natural resources are not limitless.

Currently, the role of science teachers is to enable students direct contact with nature because, as Jan Frątczak (1990) observes, the best way of learning about the surrounding environment is the direct encounter. In order to do that, one needs to give a correct example through their own everyday attitude. Effective teaching means, first of all, to provoke cognitive curiosity and to create situations when the student is directly engaged and active. It is not information reproduction but processing and drawing conclusions, and it is saved enduringly in the memory structures.

Anita Ganowicz-Bącznyk (2003) claims that the issue of education about nature has recently been discussed quite often. It is related to the problem of a man in the

modern civilization gradually wandering off farther and farther from natural space, in favour of artificially created anthropocenes. Therefore, in order to understand nature and its phenomena, it is necessary to realize that we are a part of it, not beside or above it. Due to the fact that school education has a great impact on shaping our thinking, constructivist pedagogy gives us a chance to explore secrets of nature.

According to constructivism, the learning one:

- is a nature observer themselves,
- studies dependencies taking place in nature,
- discovers sense of its existence,
- constructs knowledge about nature on their own,
- realizes that encounters with nature has a positive influence on their physical, mental and emotional development.

It is worth to remember that constructivist education changes the relation between the teacher and the student essentially. The role of the teacher is planning and organizing a proper educational environment, whereas the student is in the centre of the educational process and creates their knowledge actively.

Bożena Śniadek (1997) claims that the following premises are basis of the constructivist theory of education:

- learning depends on the knowledge and perceptions of a child,
- students possess wide basic knowledge gained through encounters with nature, society, and mass media,
- each student creates their knowledge individually,
- construction of concepts and meanings is a continuous and active process that is connected with starting knowledge,
- teaching causes changes in concepts,
- re-organization of the current knowledge,
- students are responsible for their own knowledge.

As mentioned before, in case of science education, field classes play a great role. They are not only an attractive form of teaching and learning in the process of noticing, shaping, realizing particular practical tasks, but also make it possible for students to use nature as a source of “living” knowledge. What is more, such endeavors are a chance for unassisted observations carried out by students and for taking part in the idea of beauty (as Plato tended to say) which can be approached through concretization (e.g. beautiful trees in a park), and as a proportional system of elements of a certain whole (park). Success of such classes depends on many variables but the main mean leading to achieving this goal is exploring and stimulation when both students and a teacher are actively involved, and the students try to observe and follow their teacher. One can get closer to nature through a direct encounter, not through a technique.

Teaching process based on premises of constructivism should follow these stages:

- identification of knowledge and its exposure,
- construction of new knowledge and its restructuring,
- comparing new theories to the old ones,
- implementing new knowledge (Wynne, 1996).

Presented teaching model is universal (general) enough that it can be used at different levels of school education in case of various fields, and at university or college as well. Stanisław Dylak (2000) on the other hand, notices the necessity of implementing this theory also in the process of educating teachers in training, including science teachers.

There are still issues which have not been discussed here yet. For example, an important for the constructivists issue of objectivity of the knowledge explored by the students. Dorota Klus-Stańska (2000) is afraid of the narrow science approach to teaching presented by science teachers, including requirements that a student should closely follow the stages of exploring given by a methodology of a particular scientific field. The author appreciates a significant role of an experiment in science education but suggests to create environment where students frame concepts and laws as a result of comparing their meaning with personal and general knowledge, and where the teacher would not impose the only correct, scientific solutions.

Constructivism is currently a very popular baseline for thinking of education based on child's creative, cognitive activity and on starting with child's knowledge and opinions. Stanisław Dylak (2000) claims that constructivism (as a theory of knowledge) has actually two strong points of support: the neurobiological theory of functioning of the brain and pedagogical concepts showing effectiveness of the pedagogical activity based on constructivism. Constructivism finds creating new knowledge and adopting exploratory approach by the students important. The core of constructivism is the premise that a student is a researcher inspired by the teacher. Using various sources of information, they create new knowledge (Śniadek, 2008).

As Bogusław Śliwerski points out, in the light of constructivism, the educational process must provide students with such conditions so that they are able to create and develop their knowledge. It will allow them to understand it better which will result in better understanding of the world to which it applies. The fundamental rule of constructivism is active and subjective constructing of knowledge by the exploring one.

In case of school education, a student builds their own knowledge and the role of a teacher is only to support them, not to impose their own way of thinking and understanding. That is why, according to Stanisław Dylak (2000), constructivism brings hope for teaching of reasoning. It is most probably connected with the development of reflexivity which becomes essential during learning new content and constructing own premises and theories based on that content.

The modern role of a teacher is only to motivate and create research questions for students to find solutions. It needs to be kept in mind, though, that nature can be explored not only at school for compulsory education, while learning about its characteristics through the prism of definitions from the core curriculum and textbooks. Nature is a part of our everyday life, it surrounds us, and we can observe how it changes all the time. Every second it sends us a lot of information which we often ignore. It teaches us love, humility, tolerance, thrift and other values (Buchcic, 2017).

To sum up, upbringing requires constant educational activities which should start during childhood and last for the entire life. According to the premises of constructivist pedagogy, learning and using the gained knowledge in practice is not

merely storing knowledge within a particular scientific field. It is due to the fact that cognitive process implies the need to modify learning mechanism themselves and is supposed to lead to gain competences in using certain actions taking place spontaneously and aim at improvement of acquiring information and skills in terms of quality, and cause change of cognitive structures. That is why various endeavors within formal and informal education should be undertaken in order to make nature a value for us. For this purpose, it would be worth it to use premises of constructivist pedagogy in terms of passing on information, shaping skills and environmental attitudes as a responsible approach towards environment which is a value itself.

The life of a human being is a process of realizing values through making selection and hierarchization. The right system influences our personality and makes the existence meaningful. This is why cultivation of desired sequence of values should be noticeable in a process of becoming better. It is values that stimulate and cultivate our consciousness, motivate to being active, mark the goals out, integrate people and unite societies, stimulate, orientate and stabilize development; they are an important part of a culture.

The dimension and the meaning of the concept of a value is the object of interest of many researchers representing various fields of studies. It generates pluralism in interpretation and classification of the term. The environment as a value is a very present-day issue as well as a subject area of research.

Nature as a value has been appreciated in various branches of industry and in politics; it has also been popularized in a formal and informal education. Nowadays, there are a lot of enterprises being undertaken which make it possible to emphasize this ineffable treasure that nature is. All actions that the people undertake in order to save the beauty of nature testify that nature itself may be a value. Thanks to involvement of many institutions and organizations, numerous projects are being realized. These projects concern protection of environment, preservation and enrichment of biodiversity, and formal and informal education.

Richard Louv (2014) claims that we should aim at making nature a passion for people but it is necessary to realize that a passion does not come from watching a videotape and is not recorded on a CD. Passion is based on personal experience. It comes from the ground, dug out with hands of a child. It travels from the dirty sleeves straight to the heart.

Science education according to the constructivist pedagogy may be an answer to challenges brought by globalization. However, it has to be treated by the society as a priority having a great impact on the future of all people.

It is worth remembering that knowledge consists not only of facts, rules and theories drawn from observation of phenomena and occurrences, but it is also the ability to use it rationally and to interpret those information in an everyday life.

*"Nature has always been a realm and an observation field of both science and art, it was as important for a painter and a poet as for a biologist."*

Przemysław Trzeciak

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### Abstract

In the contemporary Polish pedagogy, in the era of changes, upbringing of the youth and the need to create a new system of education become a subject of discussion. Groundbreaking systems and pedagogic methods are being searched for; the new ones are being created but at the same time, the proven ones which have a permanent place in the educational process, in case of both formal and non-formal education, are used as well.

The author notices the fact that nature is part and parcel of life and constitutes a value for a man. A human being, as the nature's building block, has a direct influence on the course of its development and therefore on its protection, which should be a priority in our everyday lives. This is why we must not forget that the process of science education is an active and continuous process which changes when new information appear – it not only complements the knowledge but also restructures it. It is worth mentioning that despite the fact that the educational process is a social and a group process, each individual explores knowledge by themselves and restructures it. In this sense, they are responsible for it.

**Keywords:** value, nature, axiology, formal education, informal education, constructivism, constructivist pedagogy, ecological consciousness, ecological culture

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