**PRIMA EDUCATIONE 2021**

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# Educating Children in Science – Ideas from John Amos Comenius

## *Edukacja dzieci w zakresie nauk ścisłych – idee Jana Amosa Komeńskiego*

**Abstract:** The article attempts to synthetically present the thought of John Amos Comenius, as a precursor of preschool pedagogy. An attempt has been made to determine what makes his thought still current in theory and pedagogical practice in kindergarten. These findings make it possible to compare what we know and what we are guided by at present. The analysis of Comenius' whole life is a combination of the value of the work itself, the format of research, organizational and journalistic activities, and the features of the times in which we live today.

**Keywords:** John Amos Comenius; Comeniology; pre-school education; science; child; learning content

**Abstrakt:** W artykule podjęto próbę ukazania w sposób syntetyczny myśli Jana Amosa Komeńskiego jako prekursora pedagogiki przedszkolnej, a także określenia, co sprawia, że jego myśl jest ciągle aktualna zarówno w teorii, jak i w praktyce pedagogicznej przedszkola. Te ustalenia pozwalają dokonać porównania z tym, co wiemy i czym kierujemy się aktualnie. Analiza całego życia Komeńskiego to połączenie wartości samego dorobku, formatu działań badawczych, organizatorskich i publicystycznych oraz cech czasów, w jakich przyszło nam współcześnie żyć.

**Słowa kluczowe:** Jan Amos Komeński; komeniologia; pedagogika przedszkolna; nauki ścisłe; dziecko; treści nauczania

## INTRODUCTION

In Europe, the idea of education (also in the field of science) is attributed to John Amos Comenius. Among other things, this was intended to be achieved by the education which was understood as *pampaedia* (the theory of permanent education – *omnes*, *omnis*, *omnino* – meaning that everyone should learn everything, comprehensively

**DOI: 10.17951/PE/2021.5.205-213**

throughout their lives; including school of birth, childhood, boyhood, puberty, adolescence, male age, old age, and death). Lifelong education is the central issue of *Pampaedia* (Komeński 1973). At the same time, it is "a modern educational concept aimed at one goal: to free humanity from the snares of ignorance, to lead him or her from darkness to »promised light«, i.e. to a truly human world" (Chodakowska 1975, p. 226). Characteristically, in the Introduction to the French edition of *The Great Didactic* [*La Grande Didactique*] by Jean-Benoît Piobetta (1952, p. 26) there was presented Comenius' idea of creating categories of schools in a specific order, rules for arranging the learning content (in a spiral), and formulating guidelines on how to conduct the process of education at schools – taking into account the age and initial knowledge of students, which, according to Jean Piaget (1996, p. 442), is to prove that Comenius is deeply acquainted with psychology. Comenius believed that:

> And although these schools will be different, they are not meant to teach different things, but rather the same things, only in different ways. I think everything that forms real people and makes the scholars the real scholars should be taught in these schools, and education is to be done taking into account the age of the student and what he has learned before, to move forward constantly. (Piaget 1996, p. 442)

In Poland, the *core curriculum for general education* takes the form of regulation of the Minister of National Education, which means that it is the law in educational institutions.[1] Being in line with Comenius' thought ensures a consistent continuation of the education process of children and youth. It is a reference document for authors of curricula. Hereby, I would also like to refer to the Regulation of the European Parliament of June 4, 2018, as it proposed to "encourage more young people to choose professions related to natural sciences, technology, engineering and mathematics (STEM[2])" (Regulation of the European…, 2018, p. 3).

Obstacles to the humanization of technical education are seen in the "Enlightenment tradition of separating the sphere of technical thought from humanistic thought, strengthened by the Western idea of secularization of science and religion" (Knosala 2015, p. 114). Combining science with the humanities is justified by the need to acquire the ability to foresee human activities' social, economic, and political consequences in the technologically evolving world by technical education students (Gwiazdowicz, Stankiewicz 2015, p. 9).

[1] Regulation of the Minister of National Education of February 14, 2017 on the core curriculum for pre-school education and the core curriculum for general education for primary schools, including students with moderate or severe intellectual disability, general education for the first-degree industry school, general education for a special school preparing for work and general education for post-secondary schools (Journal of Laws of 2017, item 356) is a document whose scope covers the stages from kindergarten to post-secondary schools.

[2] STEM – an acronym for "science, technology, engineering, and mathematics".

## THE CONCEPT OF "SCIENCE" IN THE CONSIDERATIONS OF JOHN AMOS COMENIUS. CONTENTS

In the book *Didactica Magna* [*The Great Didactic*], Comenius (1883) mentions, *inter alia*, issues related to science and seeks justification for using them. He interprets a passage from the Book of Genesis, on the basis of which he concludes that man was "placed among the visible creatures" which, in his opinion, cannot be separated. He claims that they should be treated as expectations towards man "that he should be a rational being, a creature ruling over others, (…) a creature that is the image and joy of his Creator" (Comenius 1883, p. 28). For Comenius, being a rational creature means acting in the following way:

> (…) to know the arrangement of the world and the strength of the elements, the beginning, the end and the middle of time, the changes of the sun's turns and the variety of seasons, the annual cycles of the stars and their position, the inherent properties of living creatures and the soul of animals, the powers of spirits and human thoughts, the variety of plants and root forces, in a word, everything that is hidden and that is visible. Here also belongs the knowledge of crafts and the art of pronunciation (…); in any small or large thing, it would be a stranger (…). For then he will be able to really bear the name of a sane, living being since he knows the relations of all things. (*ibid.*)

A human who has only the Creator over himself, angels equal to them, and creatures subordinate to them, to maintain his privileged position, should behave "in a royal manner", that is, "with dignity and virtue". The status granted by God places humans in divine order in such a way that it guarantees his freedom in a sense.

Regarding the third of the above-mentioned reasons, Comenius recommends a course that "represents the perfection (...) of the prototype, as he, himself says: Be holy, as I am holy, your God" (*ibid.* p. 29). In this fragment of his considerations, he states that nature requires that human: "1. (…) knew all things, 2. had dominion over things and himself, 3. that he might relate himself and all things to God, the source of all things" (*ibid.*). The desire to be understood by the readers of *The Great Didactic* makes Comenius describe the requirements he recognizes (demanded by nature from humans), using the following terms and their meanings:

- science (education) – understood as getting to know all things, talents, and languages,
- virtue or good manners – treated not only as superficial decency but also internalized and externalized ordering of activities,
- religion or piety – internal and external worship by which the human spirit unites with the Supreme Being (*ibid.*).

According to Comenius, the principle of man's superiority to other beings is based on these three requirements. These considerations allowed Comenius to:

a) justify promoting a scientific approach to the surrounding reality (embedded in the context of social behavior and life in faith expected by the society),

b) refer to the thesis formulated by him that "in man is also instilled the will to know, and not only persistence at work, but also his desire" (*ibid*., p. 33).

Other postulates in didactic matters, taken into account today, are the titles of chapters in *The Great Didactic*, e.g. "A human, if he or she is to become a human, they must be educated" (Chap. VI, p. 41), or "Human education is easiest in the first epoch of life, and it can only be held at this time" (Chap. VII, p. 45). Other issues related to the organization of the education of the young generation concern, for example, the fact that: "Young people should be taught together and that is why schools are needed" (Chap. VIII, p. 49), "All youth of both sexes should attend school" (Chap. IX, p. 52), etc.

Analyzes of the upbringing and teaching programs proposed by Comenius for subsequent levels of education made it possible to accept the thesis that "there are places for natural sciences and science in it" (Comenius 1883, pp. 28–29; Dzida 2015, p. 207). Barbara Sitarska (2018), while conducting Comeniological analyzes, also mentions Comenius' own textbook on physics (*Physicae ad lumen divinum reformatae synopsis, philodidacticorum et theodidactorum censurae exposita*) (1643), which is important for understanding Comeniology's idea of introducing children to the content connected to the science. "Jan Amos Comenius – although he was a humanist by education – published a physics textbook. He wrote about the creation of the world (matter, spirit, light), about air, earth, and water, about stars, man and angels, but also about diseases of the soul and body" (Sitarska 2018, pp. 219–220).

In his concept of education, Comenius did not omit children from 0 to 6 years old. In *Informatotium scholae maternae* [*Information of Maternity School*] (Banszel 1931; Komenský 2017), resulting from the modification of *Paradisus Bohemiae* [*Bohemian Paradise*] (a wider publication to the *Informatorium*), he provided guidelines for parents' behavior towards young children. He recommended that the learning content assigned to a given area should be implemented as a whole. He justified such a didactic vision because their scopes partially overlapped and their content complemented in real life.

In pedagogy, the idea of the layout of the areas of education, the learning content assigned to them, and the recommended methods of their implementation were considered the first curriculum for preschool education (Dymek 2015, pp. 160–161; Klim-Klimaszewska, Jagiełło 2014, pp. 177–178). He specified what should be achieved while working with children (students) at different stages of learning. Comenius prepared a child for school education – the main goal of pre-school. He recommended preparing children for the role of a student not only intellectually but also emotionally. The indications on the basis of which it was possible to infer the child's suitability for attending public school were:

- knowledge of everything that should be known in maternity school,
- finding the child's attention and keenness in answering questions and having some ability to express their own opinion,

– manifestations of a keen desire to deepen knowledge (Bobrowska-Nowak 1978, p. 48).

According to Comenius, in the period before entering elementary school (of mother tongue), a child should be given such an atmosphere in which "he or she would consider school as an institution necessary for every young person and understand that without education he would not achieve anything in life" (Kurdybacha 1967, p. 504). The program of education and comprehensive development of children from the age of one to six was appreciated by teachers (Karbowniczek 2011, p. 26). The desire to organize the process of influencing in maternity school was the reason for distinguishing the following areas of bringing up children: 1) physical education, 2) mental education, 3) education through work, 4) language education, 5) moral education, 6) religious education (Komenský 2017).

Mental education consisted of three elements: 1) getting to know things, 2) performing activities and objects, and 3) speaking. The process of getting to know things was organized by Comenius thanks to establishing a list of various concepts that he considered understandable and accessible to a young child (Bobrowska-Nowak 1978, p. 45). Analyzing the issues proposed by him, it can be assumed that they are in line with the modern division of the learning content in science – mathematics and natural sciences (astronomy, biology, chemistry, physics, and geography). In the field of mathematics, he proposed that learning mathematics in the third year of life should be completed with the ability to count up to five, in the fourth year of life – up to ten, and at the age of six – to twenty. As part of the study of geometry, such concepts as: "long", "short", "small", "large" were learned (Kurdybacha 1967, p. 503).

He planned to help children understand information connected to nature, meteorological and astronomical phenomena, and geography in natural sciences. The science of nature included both animate and inanimate content, e.g. knowledge about plants, animals, meteorological, and astronomical phenomena. He limited his study of astronomy to learning basic concepts such as "stars", "sun", "moon", etc. (Kurdybacha 1967, p. 504). In terms of organization and timing, the child was supposed to know the deadlines for timing: "yesterday, recently, a year, two or three years; understand what an hour, day, week, month means to know the names of the seasons" (Bobrowska-Nowak 1978, p. 45). Learning geography was related to the immediate environment. He assumed that the child should provide information about his place of birth and name the residence ("village", "city", "town") and know what a "field", "mountain", "meadow", "forest", and "river" are.

> He believed that the beginning of geography teaching takes place around the end of the first year and later years, when children begin to recognize their cradles and their mothers' wombs. In the second and third years, geography will mean the room they live in, etc. They should look around it when they are going to eat, go for a walk, or sleep, and they should also know where to look for light and warmth. In the third year, they will achieve an increase in geographical knowledge

> if they acquire the features and names of the room and the hallway, kitchen, bedroom, and what is in the yard, in the stable, orchard, in buildings, and around them. In the fourth year, a boy should learn about the roads leading across the street, the square leading to his neighbor, uncle, grandmother or guardian. In the fifth year, he should remember and understand what a city, hill, field, garden, forest, river, etc., are. (Dzida 2015, p. 208)

As emphasized by Wanda Bobrowska-Nowak (1978, p. 46), in intellectual education, Comenius, in such subjects as arithmetic, geometry, and music, provided for practicing practical skills supporting the work of the mind, shaping speech and dexterity of the hand. Therefore, the issue of the role of science[3] and the scope of its content in the education of preschool children is not an issue that has emerged in today's preschool pedagogy.

## INCORPORATING SCIENCE INTO THE TEACHING WORK OF KINDERGARTEN

The implementation of the core curriculum for preschool education involves considering its learning content by the authors of each preschool education curriculum. The implementation of the learning content is obligatory. The selection of learning content in mathematical and natural sciences depends on the issues anticipated for preschool children and on the observed interests in a given phenomenon.

In the final part of the core curriculum ("Conditions and Ways of Implementation"), we find a suggestion that, due to the functioning of a modern child in a dynamic, rapidly changing environment, the kindergarten should become a place where the child will receive help in its understanding. The fact that the arrangement of the space influences the activity of pupils was emphasized. It is advisable to organize permanent and temporary play areas for children. Permanent play areas include "construction, art, nature. Temporal play areas are should be related to the subject matter" (...) (*ibid*. 2017, p. 2).

The main aim of activities in the field of science is to create conditions that will enable children to acquire knowledge through discovery (active and independent formulation of the problem, searching for a way to explain a given phenomenon, the possibility of constructing knowledge through one's own analyzes and solving the

[3] The exact sciences (*nauki ścisłe*) are those sciences "in which phenomena are strictly and accurately described and modeled, and hypotheses are verified by means of experiments and mathematical proofs. Statistics are used to compile experimental data. Sciences are divided into mathematical sciences and natural sciences. The mathematical sciences include mathematics and computer science, and the natural sciences include astronomy, biology, chemistry, physics and geography" (Wikipedia 2020).

problem). A common objective for all experimental activities is to make out of them a basis for the course of action in which:

- classes begin with performing/showing/saying something non-standard,
- students are provoked to ask questions,
- students are given conditions for seeking answers,
- conclusions are formulated jointly,
- students are encouraged to formulate an understandable definition of a process/phenomenon,
- everything can be applied in everyday life (Bartkiewicz 2020, p. 33).

Such initiatives taken by teachers aim to draw children's attention to phenomena known to them from everyday life, which they usually do not pay attention to. At the same time, this assumption considers the importance of these phenomena in the studied topic. The child "experiments, estimates, predicts" (Regulation of the Minister… 2017, p. 7). To avoid the transmission teaching style, the project method or educational opportunities are recommended. Teachers should take care of the atmosphere and the process of constructing knowledge, and the area for sharing discoveries and knowledge (Sokołowska 2020, pp. 109–127).

The learning content in science is conducive to bringing children closer to the existence of many relationships in nature and the consequences of the human–environment and environment–human relationship (Korniluk 2003, pp. 139–157). "By participating in the scientific experience of the world, a child undertakes independent cognitive activity (...) and expresses his/her understanding of the world, phenomena, and all the surroundings with the help of non-verbal messages (...) and spoken language, as well as experimenting and distinguishing between the elements of the world of fiction and the reality" (Regulation of the Minister… 2017, pp. 4–7).

## CONCLUSIONS

Despite the passage of years, the theses formulated by John Amos Comenius remain valid. One may be tempted to say that modern man, apart from different "paths", follows the path of self-development Comenius wrote about. The idea of introducing children to the process of scientific thinking shows how strongly, following Comenius, we believe in the power of knowledge and upbringing that will make the world better. Therefore, the aim of upbringing is education, which is treated as a value that creates humanity (Sztobryn 2004; Meissner-Łozińska 2018).

Comenius postulated for "adapting the conditions and educational requirements to development opportunities, using the development potential and planning professional, highly specialized aid activities aimed at supporting an individual in the course of life" (Oelszlaeger-Kosturek 2020, p. 69). The development of science and the researches undertaken over the last century have confirmed the assumptions formulated by Comenius,

the principles and methods of teaching based on imagery, children's own activity, or learning through discovery. Moreover, "after the conducted research, his opinion on the importance of education as a mechanism for reducing social inequalities and shaping a social order based on respect for all people was upheld" (Żuraw 2019).

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