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Milestones in the Teaching of Mathematics to Children in Polish Territories from the Last Decades of the Nineteenth Century until the End of the Twentieth Century

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Abstract

In the talk, we will present persistent efforts to provide modern mathematical education to children aged 7–10 years in the period of the partitions and the two-decade interwar period. Particular attention will be paid to the works of now-forgotten Jeske (1836–1875), Jeleńska (1885–1961), Rusiecki (1892–1956). We will also underline the commitment of university professors of mathematics to mathematical education of younger children, including Banach (1892–1945). We will refer to the modern conception of teaching mathematics to younger children, among others, to the concept of children;s mathematics developed by Gruszczyk-Kolczyńska. We will observe the metamorphosis of the role of the decimal system of counting in the mathematical education of children in Poland in the period under discussion. An expanded paper was presented by the author at the 36 International conference of History of mathematics in 2015 in Poděbrady (see Domoradzki, 2015, p. 25–44).

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Introduction

In the second half of the XIXth century Poland was not on the political map of Europe. Polish lands were divided among the invaders: Austria-Hungary, Prussia and Russia. In Galicia, which was part of the Austro-Hungarian Empire, there were the greatest possibilities for development of education and science. There existed secondary schools with Polish language of teaching as well two universities in Lwów and Kraków. There was no such opportunity in possibility was not in the other partitions. Nevertheless, the scope of mathematical material and methods applied in public schools remarkably effectively prepared children to cope with everyday situations. Therefore it is important to remember the achievements of Jeske (1836–1875) (see Wachułka, 2003) in teaching children at home and in contemporary schools.

First milestone

Let *Jeske* – the author of *Little Arithmetic* (*Arytmetyczka*) (Jeske, 1873) speak: *Learning of the beginning calculus causes considerable troubles. It has the drawback that, that it can begin with the most diverse points. Then insurmountable difficulties turn up everywhere then turn up to be unbreakable difficulty. It is usually easy to start, but to carry out systematic education to the end, it's a little more difficult matter.*

Jeske first of all recommends the use of "specimens" (concrete – tokens, drawn lines, dots (the last ones do not mean other object) as follows.

In Jeske's times scores, dozens, yards and other measures were used in the calculations, so it was natural to recommend tasks that also apply to other numeral systems. For instance: how many tens are in 20 units?

How many dozens of pieces are in 20 pieces? How many 5 pence coins are in 20 pence? – If the farmer paid 20 rubles for 10 sheep, how much did he pay for 1sheep? How much did he pay for 3 sheep and for 8 sheep? – How many pencils can one get for 20 pence, if one pencil costs 4 pence.?

Ducat in gold costs 20 zł; how much is 1/2 ducat? –1/4 ducat? 2/4 ducat?

At the next monographic study of natural numbers there are more similar tasks. It is not difficult to note that in those days number ten did not have central place at the methodology of development of numerical concepts. Perhaps this is a consequence of the fact that the task of school education was then to prepare to cope with life situations. And at the calculation here were used, among others, feet, cubits, pounds and many other measures.

It is necessary to add here that Jeske in his concept of mathematical education of children refers to the ability shaped in home education. He says in the *Arithmetic*: "Children acceding to learn Arithmetic should be familiar with the counting and solving simple tasks within one hundred; This will facilitate the understanding and assimilation of theoretical explanations and definitions…".

How innovatively Jeske discusses the education of children and young people can be seen by studying his *Pedagogics*… (Jeske, 1875). In this handbook for teachers among others he introduced the concept of the teaching of arithmetic. Let us note and emphasize that Jeske in this and other publications refers to the famous book of already mentioned Piramowicz (1735–1801) Teacher's Duties (1787), in which the author pointed out regarding the mathematical education of children: "Giving examples and exercises in arithmetic, always should be based on these things, on the circumstances, which take place in the life of rural places and small towns. Let them write lists of harvests, wages of service division for a number of some measure, food and etc." Jeske also recommends systematic, regularity and repeatability at the mathematical education, as well as the binding of school education with life situations of contemporary students.

From these examples it is clear that Jeske at the same time proposes a written addition, subtraction, multiplication, division, division with the reminder.

He justifies it so: it is wrong to look at teaching of calculus only as a teaching of four operations, rule of three (proportion), fractions. He considers this perspective as a false. Literally on every page of *Little Arithmetic* developed by Jeske one can recognize the efforts to expand knowledge about the environment and prepare students to deal in a world of numbers and the changes that have taken place with the changes in ways of measuring the size.

This particularly applies to the arithmetic textbook (as I was able to determine, third edition of *Arithmetic* (Jeske, 1904) took place in Warsaw in 1873, for the use of Article it was used VI edition (1904), developed and supplemented by Kamiński (1847–1915). The textbook emphasizes that in France at the beginning of the century there were introduced measures characterized by great simplicity and ease of use. This system was adopted in many countries, including Austria and Germany.

There is no doubt that due to Jeske findings the metric system was introduced to the teaching of arithmetic (in this way decimal measures were included). This does not mean that other measures were forgotten, but the information about them have already played a secondary role.

Analyzing the later concepts of mathematical education of children one can conclude that the pedagogical findings cited by Jeske became perhaps the basis for all the subsequent concept of mathematical education of children. Learning the concepts of numerical ordered by decimal system and the decimal system as the basis for the formation of sense to measure and decimation logic units of measurement have been correlated with each other.

That's how Jeske settled decimal system in the mathematical education of children is so significant that it can be considered as **the milestone of mathematical education at the primary education**. Jeske's findings caused **educational metamorphosis of decimal system – it was begun to treat as the basis for both the development of numerical concepts and calculating skills, such as the implementation of children to understand the meaning of measurement of the continuous size and to form the measuring skills**.

Second milestone

The methodology of teaching children arithmetic and geometry by L. Jeleńska in collaboration with Rusiecki (see Wachułka, 2003) developed more than 30 years later, merged the two above mentioned correlated training fields based on the decimal system.

The authors clearly remarked: "An important (…) basic concept that children have to get already in the I class (although not in its entirety), is the notion of **decimal system"**. They recommended *to extract ten as a primary group*.

The understanding of the separation is notable: *a special careful exercise and emphasize of our calculating system*. According to the authors, when a child goes to the second and third class, the next decades they individually get *the concept of returning ten as ordering of calculating*. Such a concept is not considered to be synonymous with the term decimal system, it is its <u>ground</u> [emphasis S.D.]. Jeleńska decisive moments of particular methodical importance are: *Crossing the decimal threshold in adding, subtracting and adding a "few"*. The child should still learn to crystallize the concept of positional system, including important information that each unit of a higher order includes 10 units of lower order.

Methodology developed by Jeleńska before the Second World War for the next years set the course of the process of shaping concepts and math skills of children.

Simultaneously, the validity of the decimal system in the teaching was emphasized by the Polish School of Mathematics: Banach, Sierpiński, Stożek. The textbook written by them *Arithmetic and geometry for the V class of primary school* (Lvov–Warsaw 1933) introduced, among others, the decimal system semantically.

The semantics given by outstanding mathematicians is on two levels, both for the capable and less capable student. For the capable student the word *some* will be generated model, while for the less capable one this is isolated model, which relates to balls. Let us note that the same meaning is for students with different mental levels. The presented teaching situation (*we collect balls in the dozens, then collect tens to hundreds…*) we can manipulate as it would be with the money.

Consequently mathematics professors, authors of the textbook lead semantics on two levels for the capable and less capable student. I wish we had referred today to their proposals, because these eminent mathematicians of Polish School of Mathematics had written textbooks in such way that teachers could open to students the world of mathematics in the most appropriate way. They did not prefer understanding to the mathematical precision, they cared about the lecture, illustrative, and task functions of the textbook. Their books had a broad spectrum, parts intended for weaker and talented students can be clearly seen. A student could use this textbook independently, but this textbook helped teacher significantly in their work. Situations, given in the textbook, were from the everyday experiences of students from different disciplines, which in the minds of the student may raise the need for recognition of these situations in a more general way, which in turn can lead to abstraction.

It must be emphasized here that the methical findings of Jeleńska and Banach, Sierpinski and Stożek are **the another milestone in the mathematical education of children on the road designated earlier by Jeske**. These

findings in the postwar time had set the place and the ways of familiarizing children with decimal counting system and using it in mathematical activity.

Third milestone

The next change with the rank of a **milestone** in determining the place of decimal counting system in the education of children took place at the turn of the XX and XXI century. It is the result of research on the regularities of the formation of numeracy.

Here one should mention studies of Gelman (Gelman, 1980; Gelman, Gallistel, 1978) and Polish research carried out by Gruszczyk-Kolczyńska (1992). In these studies it was found that numeracy is formed in the minds of children as grammar of the native language. There was described how children discover and assimilate the rules, which are used during the counting and using them to improve numeracy. Gelman determined that they are: one-to-one rule, the rule of ordinal independence, the rule of cardinality and the rule of abstraction. On the basis of this research Gruszczyk-Kolczyńska confirmed ways of setting the rules for children and added one more – the perception of regularity of decimal system of counting and use of them. The discovery of this rule allows children to count to an increasing extent, is the basis of correct writing of numbers and counting skills at all school levels.

Gruszczyk-Kolczyńska on this basis developed the educational model of support children in forming counting at primary education and school education. In the book (Gruszczyk-Kolczyńka, 2014) she proposes a separation of mathematical education of the integrated education, as several years of school practice proves that the implementation of the mathematical education in the Convention integrated education brings a lot of damage. She also shows what to care and what to avoid so that children love to study mathematics and to succeed at education and life. From her research (see Gruszczyk-Kolczyńka, 2012) on mathematical abilities we can notice, that children at school lose the joy of learning mathematics and become less creative. The concept of Gruszczyk-Kolczyńska emphasis on skillful management of the learning process of children to build in their minds certain concepts and mathematical skills. Solid psychological knowledge and a good knowledge of models shaping concepts and mathematical skills is required from the teacher.

Conclusion

The amazing thing is that in the educational concepts of Jeske, Jeleńska Banach, Sierpiński and Stożek, you can find a lot of methodological solutions that are tailored contemporary psychological and pedagogical knowledge. This applies not only to the role of the decimal counting system in the mathematical education of children. It is worth going back to those papers and read them again for the benefit of raising the level of mathematical education.

One should reach to the historical sources, use of didactic proposals contained there, modify them by reading them again, adapt to the current proposals. It seems necessary to acquaint present and future teachers with them.

Literature

Banach, S. Sierpiński, W., Stożek, W. (1933). *Arytmetyka i geometria dla V klasy szkoły powszechnej*. Lwów, Warszawa.

Domoradzki, S. (2015). Kamienie milowe w nauczaniu matematyki dzieci w Polsce od ostatnich dekad XIX stulecia do ostatnich dekad XX w. In: J. Bečvář, M. Bečvářová (ed.), *36. mezinárodní konference Historie matematiky* (p. 25–44). Praha: Katedra didaktiky matematiky MFF UK, Matfyzpress.

Gelman, R. (1980). What Young Children Know about Numbers. *Education Psychologist*, *14*, 41–46.

Gelman, R., Gallistel, C.R. (1978). *The Child's Understanding of Number*. London: Harvard University Press.

Gruszczyk-Kolczyńka, E. (1992). *Dzieci ze specyficznymi trudnościami w uczeniu się matematyki. Przyczyny, diagnoza, zajęcia korekcyjno-wyrównawcze*. Warszawa: WSiP.

Gruszczyk-Kolczyńka, E. (red.) (2012). *O dzieciach matematycznie uzdolnionych. Książka dla rodziców i nauczycieli*. Warszawa: Nowa Era.

Gruszczyk-Kolczyńka, E. (red.) (2014). *Edukacja matematyczna w klasie I. Książka dla rodziców i nauczycieli*. Kraków: CEBP.

Jeleńska, L., Rusiecki, A.M. (1938). *Metodyka arytmetyki i geometrii w pierwszych latach nauczania*. Warszawa: Nasza Księgarnia.

Jeske, A. (1873). A*rytmetyczka*. Lublin: Księgarnia Stanisława Arcta.

Jeske, A. (1875). *Pedagogika,obejmująca zasady i metody moralnego, fizycznego i naukowego wychowania dziatek*. Warszawa: Księgarnia Stanisława Arcta.

Jeske, A. (1904). *Arytmetyka. Kurs elementarny*. Warszawa: Wydawnictwo Michała Artca.

Piotrowski, W. (2003). Jeleńska L. W: S. Domoradzki, Z. Pawlikowska-Brożek, D. Węglowska (red.), *Słownik biograficzny matematyków polskich*. Tarnobrzeg: Wyd. PWSZ.

Wachułka, A. (2003). Jeske A. W: S. Domoradzki, Z. Pawlikowska-Brożek, D. Węglowska (red.), *Słownik biograficzny matematyków polskich*. Tarnobrzeg: Wyd. PWSZ.