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Journal of Preschool and Elementary School Education nr 2(2), 69-88

2012

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The Importance of Mathematical Difficulties and Failures

Maths together with the Polish language or science is one of the primary areas of a human's education. Its importance within education is not equal to the level of difficulties in learning. An integrated part of the process of learning maths is the ability to overcome difficulties on one's own. Following the point of view of Marta Bogdanowicz, the difficulties experienced while learning widely depend on various factors: for example, mental disorder, injuries of sense and movement organs, neurological diseases and emotional disorder. In a restricted sense, this term is applied to children who do not succeed in learning except in propitious circumstances (Pilch and others, 2005, p. 816).

We can talk about difficulties when we observe a big difference between the demands made by an educational institution, and the results achieved by a child. Ludwik Bandura (1970, p. 27–138) introduced a classification of difficulties:

Difficulties in acquiring knowledge

A teacher who prepares a concept for a lesson should apply proper methods, taking into consideration not only the subject, but also the individual needs of pupils. It mostly happens that during a class it is possible to apply not only one method but two, three or even more; they can be intermingled. A domain of contemporary education should be the problematic elaborations of the subject; of course, these methods allow for the search for knowledge through everyday experiences, basing on internal experiences and observation, then on using knowledge in

practice. For the good of the child, while preparing him or her for a proper and reasonable perception of information, it is not correct to follow trends and proclaimed requirements. This is a moment when one should decide to come back to a traditional model of teaching, which means informative methods.

Moreover, the sense of acquiring knowledge is inherent in the proper assigning of difficulties, beginning from the least and gradually moving towards larger ones.

Difficulties in acquiring skills

In the process of learning, a child requires not only knowledge but also some skills. There is a strict connection between skills and knowledge; they are closely correlated. It is not possible to acquire knowledge without skills, and possessing skills demands some knowledge.

Difficulties in memorizing

We often face difficulties with memorizing; they are strictly connected with fixing systematically and applying some parts of material. Learning skills acquired by pupils will help them to actualize forgotten gaps.

Difficulties in feeling confident

There is some emotional base connected with the process of learning; it influences the achieved results. A child who has low achievements in learning feels worse; he or she suffers from a lack of confidence; he or she become more convinced about its weaker intellectual abilities. A children's status among schoolmates is low; they mostly isolate this child from the group.

Difficulties in the practical use of knowledge

The child that efficiently exists in the surrounding environment is not only a "walking encyclopaedia" highly equipped with theoretical knowledge. This is also a small human being who is able to apply possessed knowledge in practice, whilst also acquiring more knowledge.

Taking into account the specificity such a subject as maths, initial difficulties are noticed in the first years of a child's life when it has problems: for example, while building from blocks or drawing. The next symptoms are recognized at the pre-school age, while pointing to the right and left sides, distinguishing and remembering numbers, arranging numbers in decreasing and increasing order, both memory and with fingers counting, identifying numbers with written symbols (for example, a child can count but it can't read numbers), reading and understanding mathematical symbols (plus, minus, etc.). At an older age, a child cannot copy a sentence into a notebook correctly, nor do a test on its own; the world of figures and other mathematical symbols seem to be witchcraft. We must distinguish manual difficulties from those that are specific. There is a group of children who, apart from trying at the proper time, are not able to acquire the knowledge and skills included in the syllabus that is compulsory at a certain phase of education.

It happens that those children get positive marks but they are not equal to the extension put in the process of learning. Those poor effects are the product of hard work, for both children and adults, parents and teachers. "Such cases are said to be difficulties with learning maths." (Gruszczyk-Kolczyńska, 1992, p. 6). This phenomenon is strictly connected with idea of maturity in a class system proposed by the school.

The range of maturity to learn maths involves:

- a child's counting,
- emotional maturity,
- operating thinking at concrete level,
- understanding the sense of length, liquid and weight measurements,
- the ability to separate from counting on fingers and use graphic and symbolic representatives in counting and calculating;
- the ability to coordinate perceptive and manual activeness (Gruszczyk-Kolczyńska, 1992, p. 18).

Neglected natural or specific difficulties are transformed into failures. Following Jerzy Nowik, we can find the causes of mathematical failures among children in early-school education in three areas:

- family and social environment at a pupil;
- school education;
- inside a pupil with its abilities, sensitivity and psychic (Nowik, 2009, p. 182).

The environment in which a child grows and learns has a significant influence on the later process of mathematical education and its effects. The essential condition to fulfil all a child's needs and proper development is a healthy family structure, a suitable internal atmosphere, as well as socio-economic conditions. Examining the reasons from within a child's home, it is essential to focus on the destruction of family structure, the parents' improper attitude towards a child and a lack of interest in its education; moreover, not assuring the proper conditions for education and participating in the lessons, the low cultural and intellectual level of parents, lack of understanding, bad patterns and also poor living and material conditions (Przetacznikowa, Włodarski, 1980, p. 280–284; Wojda, 2001). Very often a child is threatened at home by maths, by parents, grandparents and older siblings or friends, just before going to school. In this way, a child is not shaped in a proper direction, and does not respect maths, but fears it (Nowik, 2009, p. 184). Apart from negative patterns and conditions, we should mention those that seem positive, resulting from love towards a child, but which are in fact negative. Pampering and doing something for a child - undertaking its activities. This attitude on the part of relatives makes it impossible to prepare children for life and duties, which means children cannot follow discipline and school requirements. Children will back out instead of undertaking any effort to overcome difficulties, what can be visible when solving mathematical tasks.

The second, important factor of failures within mathematical education is didactic activity. Some teachers can see the sources of school failures in the bad work of a teacher, especially:

- a limit to authorized teaching, not appreciating the method of teaching based on independent thinking and experimenting;
- an anomaly in the organization of work during a lesson;
- applying improper methods of teaching, not assuring the possibility of independent discovery, the experience of new things and abilities within mathematical education;
- a lack of respect for the rule of gradually defined tasks;
- poor knowledge used in practise;
- poor control and assessment of acquired skills and knowledge;
- a not well selected textbook;
- lack of knowledge about pupils;
- lack of care for pupils showing mathematical problems;
- an improper atmosphere during a lesson and teacher's personality (Przetacznikowa, Włodarski, 1980, p. 184–191; Łuczak, 2000, p. 37–38; Kuchta, 2001).

To these groups of causes belong not only the harmful activities of a teacher, but also some independent factors, which influence some actions in the process of teaching. These are: pupils' overworking with too many duties connected with carrying out of the school syllabus, too many pupils in a class, lack of basic teaching tools, and too extended bureaucracy. A teacher in their everyday didactic work is not able to devote much notice to every child and treat them individually.

The third area is determined by numerous factors. One of the most essential is, as mentioned above, is a lack of maturity to learn maths in school conditions. The next one is a student's poor health, long-lasting illnesses that lead to a high level of absence from maths classes which results in backlays and gaps in knowledge. When this deficiency is not revised, it becomes bigger and bigger and causes more difficulties among children. Poor health decreases a child's general possibility to work so it can memorize and remember less; he or she then easily becomes bored or tired and unwilling to work. To this list we should enclose eyesight, hearing and movement disorders. Weak eyesight can cause improper task deciphering, inaccurate copying and then it

can lead to error reinforcement. Disturbance of visual analysis and synthesis can cause the mistaking of mathematical figures and signs with those that have a graphical similarity, not the proper space of the material on a sheet of paper, making mistakes while writing or deciphering fractions, problems with recognizing and understanding information from graphs or diagrams, failures in learning geometry, problems with drawing and deciphering the function graphs, an upper and lower index that is misleading. Weakened hearing causes serious results too, because not hearing words leads to gaps in knowledge, an incorrect register of sentence that has been heard and mathematical operations, not being able to understand longer verbal orders, problems when answering the orders and verbally asked questions. A child's reduced manual skill makes it difficult or even impossible to perform charts, pictures, trees or graphs, which are very essential in mathematical education (Bandura, 1970, p. 17–21; Pawlik, 2011, p. 11–12). The next significant determinant that causes large difficulties in the process of learning maths is lateralization; this means turning and rearranging of figures (letters) while writing, missing and misleading figures (letters) while deciphering, the difficulty in mastering ideas and describing spatial proportions, less graphologic-motoric effectiveness (a slower pace of work, reduced precision). Poor techniques of reading and understanding the read texts negatively influence the understanding of the contents of tasks, understanding the sense of read mathematical rules and thus applying them. Moreover, the pace of work, with exercises that need to be read, decreases. Graphologic -motoric disorders contribute to mathematical failures; they cause problems with deciphering written orders and problems with contents, with writing down mathematical signs and symbols, with written calculation because figures have been written in an improper place, and with fast writing which leads to reduced time for calculations (Pawlik, 2011, p. 12).

The process of failure formation is not short, it develops through four phases of development which has been described by Jan Konopnicki (1996, p. 18–20) as follows:

Phase I

When the first gaps in mathematical knowledge appear among children, adults do not them. They rather think that it is only temporary problem and the child will pick them up when they do exercises. Then, when a child does not cope with calculating, adding or subtracting the objects only when it touches them, he or she cannot orientate in space very well, he or she cannot focus on the activity that is being undertaken, etc., then the first signs of disappointment with learning appear, which is a lack of willingness to go to kindergarten, then to school. A child feels a lack of confidence and perceives himself or herself to be worse than the others.

Phase II

This is rather a school period. A child shows a serious lack of knowledge; he or she is able to cover this up and can be considered to be a good pupil. He or she wants to deceive the teachers and parents, copies homework, asks neighbours for help during tests or cheats. A child does this without any consideration, automatically, without a willingness to understand or analyse the problem and understand the solution.

Phase III

At this phase both parents, teachers and even schoolmates can remark on the problem because bad marks are given. Then the first attempts to help are undertaken in order to counteract the mathematical difficulties: doing homework with a child, additional classes to pick up the material, private lessons. Because of fear and terror, a child shows characteristic psychological symptoms: shyness, aggressive behaviour during a lesson, consistently fails to do homework, passive participation in classes, aversion to maths that borders on hatred, and the consequent avoidance of maths (headaches, stomach aches, faints, playing truant, skipping lessons, etc.).

Phase IV

The final phase is the official statement about a child's failure at school and the awarding of a negative grade, which means repetition of

the school years. It causes aversion among most pupils to undertake any trials to understand mathematical problems, limits the interest in the subject, cause various interiority complexes, it can even lead to inhibiting the, until this point, normal mental development of the child.

How can we help a child to prevent difficulties and failures? The issue of development assistance is certainly a sensual organized process of picking up and handing down knowledge, simultaneously with taking into consideration a child's personal experiences, which are the elements needed to build mathematical knowledge. At the nursery phase of development, before a child goes to kindergarten, parents are the ideal teachers-therapists.

The role of parents at the early phase in overcoming mathematical difficulties and shaping mathematical ideas is emphasized by Colin Rose and Gordon Dryden. According to them, parents are "the first and most important teachers of their child. They, when playing together, show examples of problem solving and patterns to imitate. The more often a child is faced with different problems while playing, the better he or she will cope with them in the future. The more we encourage a child to think and make conclusions, the better it will be able to understand the surrounding environment. Thus, let's encourage our child to work with mathematical accuracy; it will start to understand that the world is ruled by the certain laws, steady law and order will help to live normally. The key to success is everyday play, during which a curious child enters into the world of logical connections between formulas and colours, a distinction of sequences and the event results interpretation" (Rose, Dryden, 2009a, p. 9).

How can a child play in order to develop his or her mathematical abilities efficiently and which will allow them to overcome difficulties?

1. State the common relationships between objects, pointing also at their practical appliance.
2. Compare the sets of objects according to their number, teach your child to estimate the quantity from "the first sight"; for example, there is a little and there is a lot of.

3. Show and explain the sense of mathematical operations when a child does them in concrete situations.
4. Put different patterns from the constant number of elements (Jagiełło, Klim-Klimaszewska, 2011, p. 114–115).

The authors in the publications suggest a lot of different ideas, but they mostly concentrate on discovering a real life through all senses in a pleasant atmosphere. They express this in the words: "It is necessary to emphasise that even all games which we propose, will not replace for the child the time spent together with his or her mother in the kitchen, shop, laundry, bank – take your child with you if only it is possible." (Rose, Dryden, 2009b, p. 103).

At the further level of education, teachers become parents' partners. Teachers continue the journey around the mysterious world of maths begun by the parents. They shape ideas and mathematical abilities, so that they could be proper for child's way of thinking, understanding and learning-from manipulation with concretes, through verbalisation and gestures, drawing symbols. It is not possible to teach a child how to count without mathematical operations, only by talking about numbers, in what order they appear, or how to add or subtract. Even a very colourful picture cannot help in such a case. Children should take into their hands an object of their choice, and whichever they like (blocks, chestnuts, buttons) and manipulate them: for example they can put some buttons on the floor and count them, next a teacher will add two buttons and children will count the total; afterwards they put away five buttons into a box and count the rest. After such a series of tasks, it is possible to undertake exercises based on pictures and symbols. The chosen methods of working and teaching tools should be adjusted to children's possibilities and needs.

To overcome difficulties connected with imparting and acquiring mathematical knowledge, it is worth moving away from traditional methods and common schemes and introduce some measurable improvements. One of them are innovative methods, forms of working with a child, as well as didactic devices. They are especially important when

teaching children with special educational needs to achieve better didactive and educational results.

The innovative methods include:

- The teaching method developed by Glenn Doman, assisting logical-mathematical thinking from the first moment of a human's life. Glenn Doman proposes a first set of cards for newborn babies with dimension 38 cm x 38 cm with spots on them, painted in red, with a diameter about from 3.8 cm to 4 cm. Red is the colour perceived most easily by retina receptors. It is possible to apply black or colourful signs among children at the age of 9 months, after 1 year the colour of the sign is not important. The educational process begins from a card with one spot; it is essential to keep the card motionlessly at a distance of 50 cm and repeat 'one', then put the card aside after one or two seconds. Then, analogically, the cards with two, three etc. spots are shown. At the next stage, it is essential to introduce simple, two-degree rules concerning the adding of two elements, the result, product and quotient. When children are acquainted with numbers from 1 to 20, instead of a simple session with equation, it is necessary to apply sessions with both equation and inequation. In this way, step by step, an adult introduces a child to the world of mathematics. The following exercises are accompanied by asking questions and searching for the answers. This ability is a very essential link for the process of thinking. Children, from the very beginning, are able to gain enough confidence and efficiency to formulate and ask questions.
- Maria Montessori – correlation of contents, a characteristic of pedagogy developed by Maria Montessori, is visible within mathematical education. A child working earlier, for example, with materials for senses development is able to prepare for getting to know the rules in the world of mathematics on their own. Practical experience in terms of comparison of size and volume of the objects makes it easier to learn the basic mathematical rules,

although children often are not aware of this phenomenon. Various Montessorian developing materials and other didactic devices enable children to classify, compare, learn numbers, the decimal system, geometrical figures, techniques of efficient calculations, and to perform simple mathematical operations.

- Rudolf Steiner – the mathematical education developed by Waldorf schools is comprised of learning about numbers, counting and two basic mathematical operations: adding and subtracting. The syllabus of mathematical education concerns stories involving numbers, e.g. Three small pigs and activity exercises, which help in mathematical operations, like stamping, clapping, throwing with sacks with beans on to certain patterns. Education concerning numbers begins with information that the most important number is one, the other numbers are only its sections. Children learn that a man is a unit but refer to other numbers: 2 – because he or she has a pair of eyes, ears, arms and legs, 3 – as his or her arm, leg finger and all the body (head, trunk, limbs). It is possible to find the number 4 in the general number of limbs, in the number of legs among animals; 5 we can find in the number of fingers or in the body of a human being with arms and legs standing astride. It is important for children to seek for the place where a certain number is hidden, like the phenomenon of the number 6, which is connected with, living beings or objects: the number of legs of an insect, the number of petals in a lily, or in a structure of a snow flake. The introduction of a child into the world of numbers happens through motion and rhythm connected in enumeration and the number sequence.

Innovative forms include among other things:

- Theatre through reference to mathematical contents
- Film in a mathematical plot e.g. Pi and Sigma
- Trips aiming to search mathematical contents in nature
- Meeting with experts within mathematics, e.g. a meeting with a master in chess, a master in composing of Rubik Cube.

There is an example set of didactic tools[1] that help the process of teaching maths on corrective-compensation classes:

1. Games with a book of Educational System PUS (Made in EPIDEIXIS). A handy closed plastic box in which there are 12 numbered blocks. The Control Set is always used with the books from the PUS series, because the numbers on the blocks are related to the numbers in the books. 32 or 24-paged thematic elaborations (maths, the Polish language, science, foreign languages), adapted to age and perceptive abilities of a child. Due to a clear and amusing form, they stimulate development of basic intellectual skills; they make a child works with PUS willingly and on its own. We open the Control Set and shift all blocks to the upper part so that all numbers on the blocks can be visible. We open a certain book, become acquainted with the order and start doing the exercises. After doing all the tasks, the blocks are in a lower part of the Control Set, in an order resulting from the given answers. We close the Control Set, turn it over and open it again. Now we see, arranged from the blocks, a three-coloured, regular pattern. We compare this with the model that existed in the book while doing the exercises. If the patterns are the same, all tasks were done correctly. If they are different, it means, we have made a mistake.

2. Games with Logico (Made in MAC) Logico is a series of books about various topics with a special board with colourful, buttons that can be pressed, on which children mark the answers and then, on their own, verify their correctness. Logico is the best didactic tool for individual work with a child discovering and developing their abilities; it stimulates a child's interest.

3. Mosaic in XXL Size (Made in EPIDEIXS) A didactic mosaic is a valuable tool that can be used for a child's development. A mosaic in

[1] The set prepared by the second year students of Education children's age, Universytet Przyrodniczo-humanistyczny A.O. Jóźwiak and A. Matejek.

XXL size contains 250 wooden elements in different colours: red, green, blue, white, orange and yellow; it is packed inside an aesthetic and hard wooden box. The mosaic helps children develop: manual skills, creative thinking, sight coordination, perception concentration, resistance, discipline, and counting. Learning through play with the mosaic takes place through imitating and colouring. This game teaches children construction and dexterity. An example:

a) Butterfly
- Compose the butterfly from geometrical figures according to the pattern.
- Count the number of elements within the butterfly's right wing.
- Count the number of elements that comprise the butterfly's left wing.
- Count the elements that comprise both wings.
- Count the number of red figures in the picture.
- Count the number of green triangles.
- Count the number of figures which form the butterfly. Every geometrical figure should be counted separately.

b) Elements counting
- How many red and yellow elements are there all together?
- Which elements are there more of, orange or yellow ones?

4. Sticks to count-countmen (for example, a manual game Stick Insect, Made in Granna). A tool for counting, sorting, measuring, adding and subtracting. An example:
- How many sticks do compose…
- How many sticks will you compose a triangle from?
- How many sticks will you compose a square from?
- How many sticks will you compose a rectangle from?

5. Mosaic from colourful coral beads! For example MOZAIC 300 elements AMUSES AND TEACHES (Made in Smily Play). The game-that is composed of various compositions develops manual skills, stimulates imagination and creative thinking. An example:

– Zosia has put the number 6 on the board. Kamil has put the number 10 on the board. How many coral beads did Kamil use, and how many did Zosia?
– Compose operation 1+7 from colourful coral beads on the beads and give the results.

6. A dice game. An example: Throw the dice. Count the number of spots on the dice. Then select to it a dice with Arabic numerals and fit the Arabic numeral to the number of spots thrown on the dice. Select a dice with Arabic numerals and fit the Arabic numeral to the number of spots on the dice.

7. Colourful numbers. Grandma has bought 10 apples to bake an apple-pie. Her granddaughter has eaten 5 apples. How many apples should grandma buy? Do the calculation by applying colourful numbers.

8. Textual task

a) By a feeding tray there were 3 sparrows jumping. Suddenly a flock of coalmice appeared. Together by the feeding tray there were 10 birds. How many coalmice appeared? Do the calculation with using kidney-beans.
b) Christopher had 8 candies in a sack; the children ate 5 candies. How many candies were left? Do the calculation with using kidney-beans.

9. Exercises with an abacus

a) Ala has bought 6 apples and 4 pears. How many pieces of fruit has Ala got? Do the calculation using an abacus.
b) Monica has received from her mother 8 lolly-pops, 2 of which she has lost. How many lolly-pops are left? Do the calculation using an abacus.

10. Magical number 7.

Do you know the magical number 7?

- This is one (we stamp our right foot)
- This is two (we stamp our left foot)
- This is three (we jump)
- This is four (we clap our hands)
- This is five (we move our arms that are bent at the elbows)
- This is six (we touch our nose)
- This is seven (we touch our head and move it towards the right and left.

11. Colourful magnets. A lady-bird has got 3 spots on the right wing and 5 spots on the left one. How many spots has the lady-bird got? Do the calculation on the board with using colourful magnets.

12. A numbered umbrella using animation shawl. The children stand around the animation shawl, they hold it. The children perform the teacher's orders: Under the shawl enter the children who:

- have the number 4 on their T-shirts. The children go under the shawl, dance and after a while come back to their place.
- have the number 3 on their T-shirts. The game is repeated in the same way as the first time.
- have the number which is bigger than 5.
- have the number which is less than 3.
- have the number which is the total of 1 and 2.

13. Funny maths-game "The first discovery". 5–6 years old. (Made in the Young Digital Planet). The aim of the programme is good fun combined with learning. During work with the programme a child gains the skill in calculating, adding and subtracting numbers, and putting elements in order. Additionally, while answering the questions or orders, a child develops such skills like: comparison of numerical collection and time deciphering; he or she gets to know basic geometrical figures, groups items according to a distinguished feature, forms collections of objects fulfilling certain conditions and estimates the numbers. Hundreds of interactive mathematical exercises shape special imagination, develop

perception and teach children to generalise. An essential feature of the programme is that an adult can follow the progress in learning and is able to help a child in a vocal form.

Conclusions

Mathematics causes troubles for the majority of societies in the world. It does not matter if a person is small or big, the word mathematics evokes a negative reaction among everybody. Experts dealing with a process of teaching maths and improving the effectiveness of education, emphasize the need to move away from schematic ways of teaching. It is obvious that the primary handicaps appear in communication. The language used by a teacher and the language of a child differ. The adult's language is sublimated, but a child uses simple language which is filled with everyday experiences. What for a teacher is natural, can be for a child too complicated. The language changes together with the development of mental ability. Every human being overcomes the following phases of mental development, enriches the vocabulary, but not always achieves the proper level of abstraction. Thus numerous problems of a verbal nature appear; a child is not able to understand the words of a teacher. According to the child, a teacher speaks an artificial, abstract language. In such situations, verification of ways of creating mathematical knowledge is necessary.

Learning mathematics successfully should be similar to learning to ride a bicycle. Everybody remembers the day when tried riding a bike for the first time, when step by step, achieved success. A small child, in order to ride a bike, uses two stabilizers. When balance has been achieved, it is enough to support it with a small stick fixed to the bike. Then, a child tries to overcome all the difficulties without any help, falls off the bike and bruise his or her head. However, bruises and injuries do notdiscourage a child; it gets back on the bike and elaborates in his or her mind the strategy to master the rules that are responsible for balance. A child has a conversation with a leading person, listens to advice. Such knowledge, created and based on experience cannot be forgotten.

Would it be possible to learn how to cycle only according to theory: how to keep balance, how to hold a handle-bar and pedals and how to bring together all these activities?

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Abstract:

The first part of the article presents the meaning of difficulties as well as their classification. It gradually moves on to natural and specific difficulties within mathematical education. It considers those difficulties that have been neglected within the analyses of the researchers concerning existing difficulties within mathematical education.

Keywords: maths, difficulties, didactic activity, innovative methods, innovative forms

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