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Formation of Mathematical Terminology in Junior School Children

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ABSTRACT

The actuality of studied problem is conditioned by the fact that nowadays development of personality is interrelated with mastering definite system of scientific knowledge. The article is intended on revealing pedagogical potentiality of reference materials as the basic mean that provides formation of mathematical terminology in junior school children. Pedagogical experience of Russian Federation elementary school teachers was the leading method applied in studying of this problem. As the result of this study there became description of work practice with reference materials and there was compiled trilingual explanatory dictionary of mathematical terms for junior pupils. These materials can be useful for elementary school teachers, directors of additional education, parents of junior pupils in process of teaching mathematics.

KEYWORDS

Junior pupil; teaching mathematics; mathematical terms; ability to use terminology; reference materials for learners; elementary school; teaching process; mathematical terminology

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Introduction

Development of person by means of mathematics is not possible without mastering definite system of scientific knowledge. Terminology is one of the main constituent parts of scientific knowledge system in mathematics. Without terminology there cannot be formulated any scientific law and therefore cannot be created any scientific theory. Without mastering relevant terms there cannot be learnt laws and theories. This determines leading role of terminology when forming in minds of pupils scientific knowledge system of needed scientific field. Process of knowledge system formation is the process of terminology mastering.

Terminology mastering demands from learners active mental work. Process of terminology mastering influences on development of learners' logical thinking because terms establish its foundation. (Serdobintseva, 2010).

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School practice shows that teachers are not satisfied by current method of terminology formation. Understanding the importance of this problem and discontent with its salvation makes teachers of mathematics look for new ways to form terminology. These ways appear to be more effective than traditional ones and for this reason there is need in experience exchange..

Literature Review

Many scientists studied the issues of terminology formation during education process. D.N. Bogoyavlensky & N.A. Menchinskaya (2013) discovered the role of mastering language semantics when learning orthography. According to studies of L.S. Vygotsky (2010) the internal speech is created out of external speech in a way of changing its function and as a consequence there goes changing in its structure. P.Y. Galperin (1985) described formation stages of mental work and of notions. N.F. Talyzina, I.A. Volodarskaya & G.A. Butkin, (1999) carried out series of studies dedicated to formation scientific notions.

However, it can be said that nowadays there does not exist completely worked out methodical concept of mathematical terminology formation in elementary school which takes into account all conditions of its realization. Deficiency in this methodic concept entails appearing of many subjective recommendations. Sometimes they are controversial to each other and therefore this does not help in mathematical development of elementary school pupils.

Aim of the Study

The article is intended on revealing pedagogical potentiality of reference materials as the basic mean that provides formation of mathematical terminology in junior school children.

Research questions

Can there be revealed pedagogical potentiality and conditions that provide mathematical terminology formation in junior school children?

Method

At elementary classes there are needed reference materials because junior pupils easily learn only those things that are in their direct perception. The more analyzers are involved in this perception the more easier and substantial will be knowledge. Dictionaries, encyclopedias, guidebooks, and tables are related to reference literature. Reference materials are intended to teach pupils more rationally fulfill learning activities. First of all, efficiency of using reference materials includes live, operative and direct acquaintance of learners with objects and phenomena of the environment. In elementary classes reference materials help to form correspondent notions. Every notion, in particular mathematical one has its name – term. (Aleksandrova, 1978) As it is known, term is inseparable characteristic of every notion, alongside with its content and volume. On the basis of terms, more often there are placed essential peculiarities of notions. All three characteristics (term, volume, content) are interlinked with each other.

Volume of notion –it is multitude of all objects indicated by one term. Content of notion –it is multitude of all essential properties of objects that are reflected in this notion. (Aliferenko, 2005) Therefore specially organized work with terms can help not only diversify process of learning new words, but increase effectiveness

in perception of new notions. In a work on terms, there is seen intense connection between disciplines. In process of mastering terminology there are realized evolving functions of mathematical education. Intellectual development of pupils when teaching mathematics can be considered as development of their abilities to comprehension of terms, mastering them and construction of new ones. In fact, all these abilities are signs of pupils' mathematical development.

Terminology –it is combination of terms, used in definite field of knowledge. (Leychik, 2006) One term is differed from another using various properties, features and peculiarities. Learning mathematical terminology by junior pupils supposes alongside with distinct envision about its volume and content, ability to use this term in process of mathematical activity and also ability to actualization of main factors related to definite term. (Kartavov, 1988) Verbal and symbolical expression have great role in process of mathematical terminology formation. Mathematical terminology of junior pupils is viewed from two positions: syntactical and semantical. Mathematical syntax determines rules of applying mathematical marks in tasks that are expressed by mathematical language. The meaning of every mathematical mark is determined by semantics. In order to form mathematical terminology in learners, there has to be definite system in work of teacher. Only at this condition, there is possible to form proper abilities in children. (Kolyaseva, 2014) Development of mathematical terminology –it is thorough and difficult work because there is needed to carry out grouped and individual lessons.

Analysis of elementary school teachers' pedagogical experience on formation of mathematical terminology

Fragments of lessons. At mathematics lessons there are used various ways of formation and establishing mathematical terminology in junior pupils. For example, general property of object can be its distinctive property if it expresses so called essential properties of this term, properties that are its signs which distinguish it out of many other notions. Human mind in process of reflecting this properties creates especial form of thought that is called notion. Characteristic points for such form of thought as notion there are: 1) notion is the product of highly organized matter; 2) notion reflects material world; 3) notion is represented in cognition as mean of communication; 4) notion means specific human activity; 5) notion formation in human mind is inseparable from expressing it by means of speech, writing or symbol.

Process of some notion formation is gradual one which has several consequent stages. This process can be shown in a simple example –forming notion in children about Figure 5.

1) On the first step of learning children get acquainted with various concrete multitudes. They not only see every one of these multitudes, but also can touch those objects that constitute the multitudes.

This process of "seeing" creates in mind of children special form of reality reflection that is called perception (feeling). Sensory perception of object is initial, simple step in its cognition by pupil –the first step in formation of corresponding notion.

2) The objects that constitute every multitude are taken away and children are asked to forget about these objects. Has there been anything common that characterize all of these multitudes? Children should have remembered that the

number of objects in every multitude is “five”. If it is so then, in minds of children, there is formed new vision about number “five”. Now it can be said that children have notion about number 5.

Description of work methods with reference materials needed for formation of mathematical terminology in junior pupils

Dialogue. The content of dialogue is intended on understanding by children that when they learn mathematics they will meet new unknown words and it should be explained to them that this is normal. Unknown word can be a new term and at the lesson they will know what this term mean. (Sokolova, 2008)

Work with notes. Often, the authors of mathematics lesson books know that definite word will be unclear to children and it should be explained to them. Then the authors make notes. With the help of teacher pupils learn notes.

Informational and research work. For pupils it is offered to find in library mathematical journal those words the meaning of which they would like to know. Children chose the words and write them down in copy books. Further, together with teacher, they find in explanatory dictionary the meaning of needed term. For better understanding, the teacher in simple words can explain found terms.

Grouped work with encyclopedia. The teacher offer a term to group of pupils for explanation. There is given a task –during several minutes to find an explanation for term using encyclopedia. Later group gives short report about understanding of this term.

Mathematical dictations. The purpose of such dictations is to check learned mathematical notions. The teacher reads questions. The pupils write down their short answers in enumerated order. Sometimes auditory perception of children needs help. Therefore at the same time there is drawn a picture or a scheme on a chalkboard. Depending on preparedness of pupils the number of tasks is increased or decreased.

The tasks on transition from literal form of writing into symbolic one and back. 1) The teacher dictates several mathematical expressions (formulae, statements), and pupils write down these expressions in mathematical symbols. 2) The teachers writes mathematical expressions on the chalkboard and pupils read them (together or individually).

Logical exercises. The teacher offers the tasks of the following types: compare, make conclusion, find regularity, continue sequence. Also, there can be offered to find mistakes in definitions. Children can show examples that point out lack in definitions. (Cottrel, 2011)

Solving and making mathematical crosswords. There are definite rules: -in every blank cell of crossword there is written one letter; -every word begins in a cell with number corresponding to its definition, and ends at ridge of crossword; -there can be included no more than three similar notions and cannot be included single root words; -answer words have to be in nominative case and in singular number beside the words which do not have singular number; -there are not used words which are written with dash and words with diminutive meaning. Pupils have to take into account these rules when making definitions to terms and solving them because only thorough definitions make crossword interesting and original.

Individual work with support schemes. Individual work of pupils with support schemes at mathematical lessons is intended on analytical work with text. Children learn to create and reform models and schemes, understand information represented in various ways: verbally, in type of table and schemes. Scheme has to be systematically capacious, short and distinct in design, simple and obvious for perception.

Work with etymologic dictionary. With the help of etymological analysis junior pupils study the origin of term, initial structure of given word and its semantic links.

Research and project work. In process of fulfilling research and project work pupils meet new terms. In order to understand its meaning it is needed to show children the work with internet queries. It can be search system, online explanatory dictionaries or encyclopedia for children (Sabirova & Zakirova, 2015).

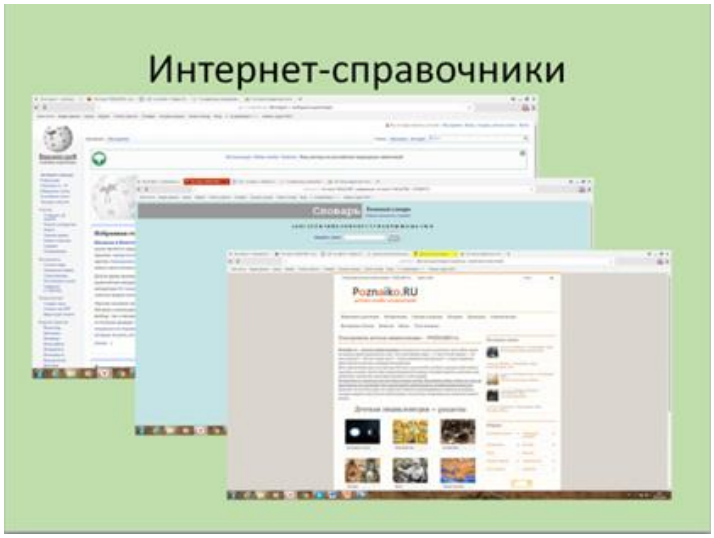
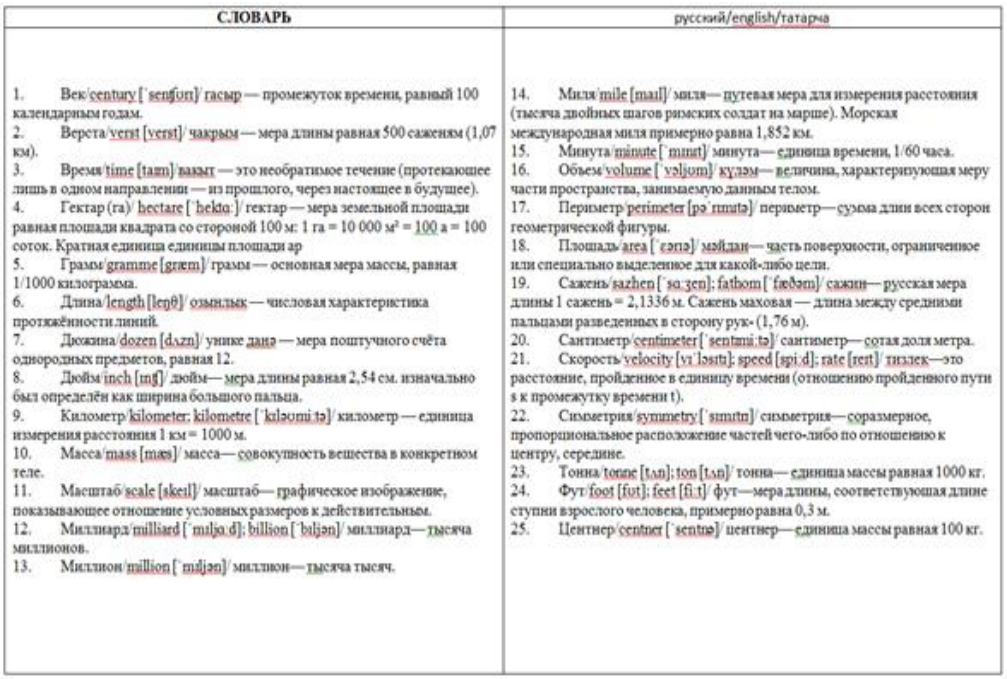


Figure 1. Internet query

For formation in junior pupils of mathematical terms needed for such topics as “Numbers and values” and “Geometrical values”, there was compiled short trilingual dictionary which includes such terms as: century, time, hectare, gram, length, inch, kilometer, mass, scale, million, billion, mile, minute, volume, perimeter, area, centimeter, speed, symmetry, ton, feet, center.



СЛОВАРЬ	русский/english/татарча
1. Век/century [ˈsenʧʊri]/ гасыр — промежуток времени, равный 100 календарным годам. 2. Верста/verst [verst]/ чакрым — мера длины равная 500 саженям (1,07 км). 3. Время/time [taɪm]/ вакыт — это необратимое течение (протекающее лишь в одном направлении — из прошлого, через настоящее в будущее). 4. Гектар (га)/ hectare [ˈhekteɪ]/ гектар — мера земельной площади равная площади квадрата со стороной 100 м: 1 га = 10 000 м² = 100 а = 100 соток. Кратная единица единицы площади ар 5. Грамм/gramme [græm]/ грамм — основная мера массы, равная 1/1000 килограмма. 6. Длина/length [leŋθ]/ озынлык — числовая характеристика протяжённости линий. 7. Дюжина/dozen [dʌzn]/ унике дана — мера поштучного счёта однородных предметов, равная 12. 8. Дюйм/inch [ɪnʧ]/ дюйм— мера длины равная 2,54 см. изначально был определён как ширина большого пальца. 9. Километр/kilometer; kilometre [ˈkɪləʊmiːtə]/ километр — единица измерения расстояния 1 км = 1000 м. 10. Масса/mass [mæs]/ масса— совокупность вещества в конкретном теле. 11. Масштаб/scale [skeɪl]/ масштаб— графическое изображение, показывающее отношение условных размеров к действительным. 12. Миллиард/milliard [ˈmɪljɑːd]; billion [ˈbɪljən]/ миллиард— тысяча миллионов. 13. Миллион/million [ˈmɪljən]/ миллион—тысяча тысяч.	14. Миля/mile [maɪl]/ миля— путевая мера для измерения расстояния (тысяча двойных шагов римских солдат на марше). Морская международная миля примерно равна 1,852 км. 15. Минута/minute [ˈmɪnɪt]/ минута— единица времени, 1/60 часа. 16. Объем/volume [ˈvɔljʊm]/ күләм— величина, характеризующая меру части пространства, занимаемую данным телом. 17. Периметр/perimeter [pəˈrɪmɪtə]/ периметр— сумма длин всех сторон геометрической фигуры. 18. Площадь/area [ˈeərɪə]/ мәйдан— часть поверхности, ограниченное или специально выделенное для какой-либо цели. 19. Сажень/sazhen [ˈsɑːʒen]; fathom [ˈfæðəm]/ сажин— русская мера длины 1 сажень = 2,1336 м. Сажень маховая — длина между средними пальцами разведенных в сторону рук- (1,76 м). 20. Сантиметр/centimeter [ˈsentɪmiːtə]/ сантиметр— сотая доля метра. 21. Скорость/velocity [vɪˈlɔsɪtɪ]; speed [spiːd]; rate [reɪt]/ тизлек—это расстояние, пройденное в единицу времени (отношению пройденного пути s к промежутку времени t). 22. Симметрия/symmetry [ˈsɪmɪtrɪ]/ симметрия— соразмерное, пропорциональное расположение частей чего-либо по отношению к центру, середине. 23. Тонна/tonne [tʌn]; ton [tʌn]/ тонна— единица массы равная 1000 кг. 24. Фут/foot [fʊt]; feet [fiːt]/ фут—мера длины, соответствующая длине ступни взрослого человека, примерно равна 0,3 м. 25. Центнер/centner [ˈsentnə]/ центнер—единица массы равная 100 кг.

Figure 2. Mathematical dictionary

Data, Analysis, and Results

Pedagogical potentiality of reference materials as the basic instrument, that help to form mathematical terminology in junior pupils, includes several key characteristics:

- mastering mathematical terminology by junior pupils supposes, alongside with distinct envisaging about its volume and content, ability to use this term in process of mathematical activity and also ability to actualization of main factors that are related to this term;
- visual material allows, when studying mathematical terminology, to refer to the nature of things, to find possibility of entering the pupil into practical activity process where there are formed images that help in mastering of taught abstractions.
- appearing of mathematical terminology in speech of junior pupils and mastering of mathematical language by them provides awareness in learning, advances establishing of mathematical thinking as unity of logic operations, ability to deductive reasoning, thinking in abridged constructions, sensible operation by sign systems of mathematical language, dimensional concepts, remembering and imagination.

In process of mastering mathematical terminology pupils sometimes make mistakes when formulating definitions. These mistakes are caused by not following the settled in logics “rules of definitions”.

Therefore the following moments should be taken into consideration:

1) Term has to be proportional. Volume of defined notion has to be equivalent to volume defining notion.

2) Term must not have "vicious circle". The definition should not be constructed in a way where defined notion is defined (in hidden or in visible way) by means of the same defined notion.

3) Term as far as possible must not be negative. It means that there should be avoided such definitions which typical difference manifests as negative notion. But sometimes in mathematics there are used "negative" notions, in particular if they are pointed out with signs that are not inherent to definite notion.

Discussion and Conclusion

Language of the modern world tends to accuracy, preciseness in definitions and to scientific exactness. It needs figures, angles, points of view, peaks of knowledge, coordinates of events, words of mathematical logics. Starting from the point that "terminology state of any science reflects the grade of its development and structure" (Baranov, 2001) it can be said that mathematical terms deeply entered our mind and our live so they do not look like terms now. These terms got mixed with neutral lexicon, became common and underwent depersonalization.

Although D.S. Lotte (1968) defining the notion of term in book "Basis of making scientific and technic terminology. Issues of theory and practice" says that: "Term is a word or subjective word combination that have special meaning which express and form professional notion used in cognitive process and mastering of scientific and professional-technic objects and relations between them".

According to G.O. Vinokur (1994) everyday words can also be terms (for example when parents teach children to call things of environment). But the main difference between every day and scientific-theoretic terms is in their function: if domestic terms have function of calling things, then scientific-theoretic term is "certainly the name of notion ".

Mathematical terminology includes algebraic and geometric terms that denote values. It is known absolutely to any educated people, because mathematical language actively used in everyday speech.

Taking into account all what was written above, it can be said that problem of mathematical terminology formation in elementary school is of great actuality. On degree of solving this problem there depends the quality of knowledge on this discipline and thought development level of learners. Mathematical terminology of junior pupils will form more successfully if there are fulfilled following conditions:

- significance of mathematical material;
- making favorable environment with mathematical activity;
- necessity in mathematical dialogue;
- detailed concretization of new abstract notions;
- attracting learners to self-dependent studying and defining of considered mathematical notions;
- revealing the link of new notion with already known notions;

- pointing out on analogy in characteristic of new notions and notions that are known;
- repeating definitions of known important mathematical notions that are interlinked with notions considered at concrete lesson; necessity of correct transferring the essence of concrete mathematical notion;
- demands on exactness, shortness and preciseness in statements of definitions.

Using of mathematical terminology by junior school children increases learning motivation, helps to establish mathematical thinking, evolves ability to deductive discourse, leads to understanding of abridged mathematical constructions. Sensible operating by terms of mathematical language is good foundation to form mathematical culture of pupils.

Implications and Recommendations

Methodical recommendations on work with mathematical terms in elementary school:

1) Work with terms has to be thorough and systemic. The main purpose of this work is formation of mathematical language in pupils.

2) It is very important for elementary school teacher to use correctly mathematical terminology.

3) The acquaintance with mathematical terms has to go in process of mathematical activity during lessons and also in extracurricular time.

4) The work on mathematical symbols has to go in parallel way with studying mathematical terms.

5) Learning of terms has to be sensible, not mechanical, therefore it is needed to use various means when revealing mathematical notion.

6) Every pupil should have mathematical reference books, which help quickly to find needed information.

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