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METHODOLOGY OF TEACHING FUNCTIONAL DEPENDENCIES BETWEEN QUANTITIES THROUGH SIMPLE PROBLEMS IN PRIMARY CLASSES

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Abstract

Teaching functional dependencies between the quantities learned in elementary grades is one of the requirements for education. Imparting the necessary knowledge to students, being able to apply the acquired knowledge in everyday life and future education directly depends on the knowledge, skills and habits acquired by primary school teachers and future classroom teachers in higher schools. Experiments show that elementary school students cannot understand the dependences of many quantities, they have difficulty in applying them. Therefore, in the article, we have given the theoretical basis of the implementation of dependencies between the quantities that will play an important role in the professional training of future classroom teachers by means of simple problems and corresponding methodical works.

Keywords: *price, quantity, value, speed, time, distance, labor productivity, work duration, volume of work*

Introduction

Training of human resources in the field of education is one of the main directions of the State Strategy for the development of education in the Republic of Azerbaijan. This direction envisages the regular improvement of the qualifications of competent pedagogical personnel who apply innovative training methods and ensure effective mastering of the content of education. The implementation of all these depends on the basic education, in other words, knowledge, skills and habits, which future teachers receive in higher schools. A teacher with high basic knowledge has the ability to improve his specialty, transfer his knowledge, skills and abilities to the new generation, and perform flexible activities. The basis of success in this subject is directly dependent on the level of mathematics teaching in primary classes. The current mathematics program (curriculum) and mathematics subject are taught in 5 content lines. These are:

"numbers and actions"; "algebra and functions"; "geometry "; "measurement"; is "statistics and probability". It is known that mathematics is the science of spatial forms and quantitative relations of the real world. As it can be seen, the study of quantities within the content lines of mathematics is not intended as a separate line. However, all units are intended to teach information about quantities. Since the quantity includes the property of being able to measure and compare objects, events, and objects, the measurement content line directly implies the measurement of quantities (Mathematics education program (curriculum), 2012). In the "Numbers and operations" section, length, mass, capacity, time, etc. during primary education. it is intended to teach quantities, their measurement and relationships between measurement units, geometric quantities in the "Geometry" content line, statistics and probability-related quantities in the "statistics and probability" content line. The "Measurement" content line is intended to teach the basics of measuring all studied quantities. The teaching of functional dependencies between quantities is included in the content line "algebra and functions".

Actuality

According to the Mathematics program of the Republic of Azerbaijan, elementary school students must determine the following relationships between dependent quantities at the end of the 4th grade.

– To interpret how the change of one of the dependent variables affects the other;

– Relating simple functional dependencies to vital issues;

– To interpret the functional dependencies between different quantities (price, quantity, value, speed, time, route, labor productivity, duration of work, volume of work);

– To express the dependencies between the quantities in the form of a formula with the help of letters. All this shows the importance of teaching quantity, its measurement and functional dependencies between quantities (Mathematics education program (curriculum), 2012).

Research

The mathematics program (curriculum) designed in accordance with the concept of Education of the Republic of Azerbaijan involves the teaching of a number of quantities in primary classes: quantity (number), length (distance), capacity (volume), mass, area, price, value, time, speed, etc. It should be noted that the educational program of the Russian Federation envisages teaching the same quantities. (Mathematics education program (curriculum), 2012 & Federal working program of primary education, mathematics, 2023). Quantities intended to be studied in elementary grades can be conditionally divided into two parts: those that have no functional dependence on other quantities and those that have functional dependence on other quantities: for example, mass, capacity, etc. In primary classes, independent quantities are formed as a result of measurement, using measuring tools directly. For example, the concept of mass is formed by measuring an object with a scale, measuring tape, roulette, etc. the concept of length is formed by using such measurement tools. Other quantities are measured by the intervention of other quantities. For example, to determine the value of the goods purchased, it is necessary to know both the price of the goods and the quantity of the goods purchased. Such quantities are functionally dependent quantities. In elementary grades, the following three groups of quantities can be attributed to such a group of quantities:

– Price, quantity and value; – Speed, time and distance (path); – Labor productivity, Work duration (time spent on work) and work volume.

Some of the quantities involved in this group of triples are also independent quantities. For example, the amount of time. In the first case, this quantity acts as a measure of the duration of the event, and in the second case, its size acts as a quantity that determines the effect on the measurement of other quantities in the given event. However, in each case, time is the measure of the duration of the event. Also, the quantity indicates the number of the item in all cases, the quantity of other quantitative units involved in the dependence. For example, if the car moved for 3 hours, it means that the number of time units (hours) of the car in motion is 3. Analysis of programs and textbooks shows that the teaching of relationships between

functionally dependent quantities is mainly carried out by means of problem solving. It is planned to teach these relationships in the 3 rd–4 th grades by solving 2–3 practical problems. In the textbooks, almost no theoretical information is given about the relations between the three quantities – proportional dependencies. In particular, the relationship between labor productivity, time spent on work (Work duration) and the amount of work performed is not theoretically justified in any way. Therefore, it is up to the classroom teachers to eliminate this gap (Federal working program of primary education, mathematics, 2023).

Application of the method of analogy

Analogy in teaching mathematics, drawing up and finding analogues of various given objects and relationships; transferring information about the model to the original, reasoning by analogy with the solution of the original problem when solving the problem; is a special training method in which actions such as checking expressions obtained by analogy are carried out (Textbooks, 2023). Here, in order to realize functional dependencies between a group of quantities, we have intended to apply the dependencies between price, quantity and value quantities to other quantities based on analogy.

Theoretical explanation

First, let's clarify the meaning of each of these quantities and note the types of simple problems related to them. Matters related to price, quantity and value are usually called "purchasing matters" or "purchasing" matters. **Price** – is the amount of money to be paid for one unit of the item to be purchased, that is, the size of only one item. For example, a box of tea, a kg of fruit, etc. the amount of money to be paid to buy it is its price. **Quantity** – Indicates the number of items of the same (same price) to be purchased. For example, 3 loaves of bread, 6 kg of potatoes. Here, the number of loaves is 3, and the amount of potatoes in kilograms is 6. **Value** – The amount of money given to all items of the same value purchased. For example, 6 manats paid for 2 kg of peaches, which are 3 manats per kilogram, is the value of all purchased peaches (2 kg). If we denote the value by a, the quantity by n, and the value by C, the dependence between these quantities can be expressed as C= a n. It should be noted that the following types of simple issues related to the dependencies between price, value, and quantity quantities are considered in primary classes: 1.1. Issues related to finding the value when the price and quantity of the goods are given; 1.2. When the price and value of the goods are given, issues related to finding its quantity; 1.3. Issues related to finding the price of goods given their value and quantity. First, let's give the rules for solving each of these issues.

a) **Rule:** When the price and quantity of the goods are given, to find the value, it is necessary to multiply the price by the quantity, C=an; b) Rule: When the price and value of the goods are given, to find its quantity, it is necessary to divide the value by the price, n=C: a; c) **Rule:** Given the value and quantity of the goods, to find the price, it is necessary to divide the value by the quantity, a=C: n. Another group of quantities studied in primary classes are speed, time, and distance quantities. Issues related to speed, time, and distance are commonly referred to as "motion issues" or "motion" issues (Guryanov, 1980). **Speed** – is the distance traveled in unit time. First of all, let's note that when we say speed in matters related to movement in elementary grades, we mean uniform movement. For example, if the car was in motion for 4 hours and traveled a total of 300 km, then it is understood that the car travels the same distance every hour, that is, 75 km. Likewise, if a car travels 80 km per hour, then the speed of the car is 80 km per hour; if a pedestrian travels 100 m per minute, then the speed of the pedestrian is 100 m per minute; etc. Although each of the latter refers to the average speed, in the problems presented in the elementary grades, we treat these speeds as the speeds of uniform motion. Let us denote the speed by V t. **Time** – is the number of units of time spent on the entire road at the same speed, the time period. For example, if the car traveled from one point to another in 3 hours, then the amount of 3 hours is the time spent on this movement. Let us denote **time** by t. **Distance (path)** is the length of the path from the beginning to the end of the movement. – Total time travelled. In elementary grades, distance is understood

as straight line movement. For example, we mark the rider's movement from the village to the city as a segment of a straight line and assume that he moves along a straight line. For example, the distance traveled by a fast moving car in 4 hours. Traveled path (distance) – Let's denote the distance (traveled path) with S. Now let's look at the relationship between speed, time and distance quantities. The following types of simple problems are considered regarding the dependences between these quantities: 2.1. Problems related to finding the distance given the speed and time; 2.2. Issues related to finding time given speed and distance; 2.3. Problems related to finding speed given distance and time. Now let's give the rules for solving each of these issues.

a) **Rule:** Given the speed and time, to find the distance, you need to multiply the speed by time, S = V*t; b) **Rule:** When speed and distance are given, to find time, distance must be divided by speed, t = S: V; c) **Rule:** Given distance and time, to find speed, divide distance by time, V = S: t The third group of quantities studied in primary classes is labor productivity, duration of work and volume of work. Issues related to labor productivity, duration of work and volume of work are called "work-related issues" or "work" issues (Ashurov, 2020). Labor productivity is the work done in a single time. For example, the work done by a loom in one hour, cotton collected by a person in one day, etc. let us denote it by a. Work duration – The total amount or number of work done with the same productivity. For example, the number of hours worked by a loom working with the same productivity, the number of working days of a cotton picker working with the same productivity, etc. Let us denote it by n. Scope of work – Work performed during the entire period of work. For example, the number of parts made by the loom in 5 hours, the amount of cotton collected by a cotton farmer in 10 days with the same productivity, etc. Let M denote the volume of work. The following types of simple problems are considered regarding the dependences between these quantities: 3.1. Issues related to finding the volume of work given labor productivity and the duration of the work; 3.2. Issues related to finding the duration of work given the labor productivity and volume of work; 3.3. Issues related to finding Labor productivity given the volume of work and duration of work.

Now let's give the rules for solving each of these issues.

a) **Rule:** Given the labor productivity and the duration of the work, it is necessary to multiply the speed by the time to find the volume of work, M=n*a; b) **Rule:** Given the labor productivity and the volume of work, to find the duration of the work, it is necessary to divide the distance by the speed, n=M: a; c) **Rule:** Given the volume of work and the duration of work, to find labor productivity, you need to divide the distance by time, a=M: n. Let's look at the formulas given for solving all three types of problems (3 types of each). Future classroom teachers should know that in each of these three quantities, while one of the quantities is constant, there is a certain dependence between the other two. When one of the quantities is constant, the relationship between the other two quantities is directly or inversely proportional. The relationship between quantity and value is directly proportional: C=a*n.

- When the speed remains constant (V = = const), the dependence between time and distance is directly proportional dependence: S = V * t;
- When labor productivity remains constant (a=const), the relationship between the duration of work and the volume of work is directly proportional: M = a * n;
- When the quantity is constant (n = = const), the relationship between price and value is directly proportional: C = n * a;
- When time remains constant (t = = const), the relationship between speed and distance is directly proportional: S = t * V;
- When the work duration remains constant (n = const), the relationship between labor productivity and the volume of work is directly proportional: M = n * a. Summarizing all three formulas, we get different written forms of the dependence y = k * x, which is for directly proportional dependence. This means that 1.1., 2.1., 3.1. y = kx mathematical model can be used for each of the problems;

- When the price is constant (a= =const), the relationship between quantity and price is inversely proportional: a = C: n and n= C: a;
- When distance is constant (S = = const), the relationship between time and speed is inversely proportional: t = S * V and V = S : t;
- When the amount of work remains constant (M = const), we get different written forms of the y=k: x dependence for proportional dependence: a = = M: n and n = M: a. Here, by generalizing all three formulas, we will get different written forms of the dependence y = k/x for the inversely proportional dependence. This means that 1.2., 2.2., 3.2. and 1.3., 2.3., 3.3. y = =k/x mathematical model can be used for each of the problems. The possibility of building the same mathematical model for problems allows them to be studied on the basis of analogy. Therefore, it is possible to learn how to solve all three types of problems jointly and with the same methodical approach (Textbooks, 2023).

Methodology of teaching the subject

In the second grade of primary classes, multiplication is supposed to be taught. When applying multiplication to solving problems, textbooks use "buying and selling" problems (related to finding value). This "movement" (relating to finding the distance) and "work" (relating to finding the volume of work) issues of training can also be considered (Textbooks, 2023).

Issue 1: One notebook is 2 manats, how much money is paid for 5 such notebooks?

The solution to the problem is to find the sum of 5 equal sums, in other words, to apply multiplication: 2 manats * 5 = 10 manats.

Problem 2: They bought 5 identical notebooks. If one notebook is 2 manats, how much money will be paid?

The solution to this problem is to find the sum of 5 equal sums, in other words, to apply multiplication: 2 manats * 5 = 10 manats.

In solving these problems, the terms price, quantity and value can also be used quantitatively: Here,

– 2 manats is money given to a notebook, which means its price;

– 5 is quantity, indicating the number of identical items purchased;

– 10 manat is the value, the purchase is the money given for all things.

After the formation of knowledge about these quantities, an analogous problem concerning the second group of quantities can be presented.

Problem 3: A pedestrian travels 4 km per hour. How far will it go on foot in 3 hours?

Issue 4: He walked for 3 hours. If he traveled 4 km per hour every hour, how far did he travel in total?

Even if the students do not know the names of the quantities as terms in solving these problems, they do not have any difficulty in solving the problem. The solution to the problem comes down to finding the sum of 3 equal sums, in other words, applying multiplication: 4km*3=12km. Therefore, the meaning of the quantities speed, time and distance must be exclusively explained in solving these problems. In the 2nd grade, for the purpose of strengthening the act of multiplication, one can offer a problem related to the third type of problems.

Problem 5: A tailor sews 3 shirts in one day. How many such shirts in 5 days?

Problem 6: The tailor worked for 5 days. If he sewed 3 shirts every day, how many shirts did he sew? In these matters, sewing 3 shirts every day means labor productivity, 5 days means the duration of work, and the sought quantity is the volume of work. This problem is related to finding the volume of the work, the solution comes to finding the sum of 5 equal sums, in other words, applying the multiplication operation: 3 shirts * 5 = = 15 shirts. At this stage, in "purchasing" issues, when the price and value of the goods are given, the issues related to finding its quantity (1.2.) and the issues related to finding the price of the goods when the value and quantity are given (1.3) can be considered. In other words, in "shopping " issues, one can look at issues where the value remains constant. Each of these issues comes under the application of the division act. Therefore, in the process of formation of knowledge about the act of division, it is possible to consider the formation of quantities (Ashurov, 2021).

Issue 7: Azer has 24 manat money. One notebook costs 4 manats. How many such notebooks can he buy?

Issue 8: Azer bought 6 identical notebooks for 24 manats. How much is a notebook? The 7th problem is of the type of problems related to finding the quantity of goods when the price and value of the goods are given. According to the rule, the solution of the problem comes to the application of the act of division: 24 : 4 = 6 (notebook). In solving this problem, students can use the words "price", "quantity" and "value", which are exclusive knowledge, and explain their meaning.

– "4 manats" is the money given to one notebook, this is called the price of those notebooks;

– Found answer – "6 notebooks", the number of the same notebooks purchased is called the quantity;

– "24 manats" given in the question is all the money given to 6 notebooks with a price of 4 manats, this is called value. After such an explanation, it would be better to change the content of the question: how many notebooks can be bought for 4 manats for 24 manats? The 8th problem is related to finding the price of the goods when the price and quantity of the goods are given. According to the rule, the solution of the problem comes from the application of division: 24 manats: 6 = 4 manats. In the solution process, the explanation in problem 7 can be repeated analogously and the content of the problem can be changed as follows: Azerin bought 6 identical notebooks for 24 manats. Find the price of the notebook (or How much is the notebook?) Issues related to "Movement" can also be included in teaching with a similar methodical method. Although specific lesson hours are allocated to the study of price, quantity, value, speed, time, traveled distance quantities from the mathematics program, there is no place and time allocated to the study of productivity, work duration, work volume quantities. The study of these quantities, like many quantities, should be done through problem solving. Therefore, when solving the issues related to "shopping" and "movement", it is necessary to include "work" issues in parallel (Volkovyssky, 1976).

Discussions

Theoretical studies show that the three mentioned quantities are studied separately. From these quantities, functional dependencies for price, quantity and value quantities are realized from the 2nd grade, after teaching multiplication and division operations, while the realization of functional dependencies between other quantities of speed, time and distance is realized from the 4th grade. Functional relationships between labor productivity, work duration and work volume quantities are viewed very superficially. All three types of problems can be achieved by using the first types of problems when verifying knowledge about multiplication. After learning division, all three types of problems can be achieved using types 2 and 3. Also, this realization can be done by solving simple problems, which will not cause difficulties for students to acquire knowledge about the appropriate quantities. Such problems, which are propodeutics of direct and inverse proportional dependencies between these quantities, will be of great help to the study of the subject of functional dependence in the future.

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