

The Integration of Mathematics Instruction in Elementary Education

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Abstract: *The division of mathematics in several scientific disciplines in the previous century resulted in significant differentiation in the mathematics education in primary and high school education, something that can be noticed in elementary education as well. The differentiation comes with many shortcomings, which primarily reflect in the insufficient development of the cognitive properties, and in the inability to present a complete and uniform illustration of nature to the young generations. Hence, there is a need to improve the integration of instruction, not only of the inter-subject and intra-subject, but also the integration of the instruction with the immediate environment. This is very important in terms of the elementary education. In this paper we will analyze the integration of mathematics instruction, and we will present examples, which may serve as guidelines for its successful realization.*

Keywords: integration, differentiation, mathematics instruction

2010 Mathematics Subject Classification. Primary 97D40; Secondary 97D50

1. Introduction

The division of mathematics in several scientific disciplines in the previous century resulted in significant differentiation in the mathematics education. A direct consequence of this is the development of the thinking properties of the students, to be more specific, the elasticity, practicality, rationality and depth of thinking. This exaggerated differentiation makes it impossible to present the young learners with a complete and uniform illustration of nature, society and their place in it. It can also be an obstacle to integrally learn the mathematics content and to acquire complete and usable skills and abilities. In the last decades, there is a tendency for integration of the mathematics education in order to overcome the traditional division of the instructional content in separate, isolated units. In elementary education efforts are made to attain this objective through the study of sets, work with data and solving elementary logical tasks. Mainly, these tendencies are justified by the importance of the mentioned content for the development of the children; however, in this case, the following facts are not taken into account:

- The Venn diagrams and Table diagrams (Carroll's diagrams), even at elementary level, are abstract for most of the students.
- It is necessary to learn them completely in order to attain complete structural knowledge at a higher level, which of course is not a primary objective of the mathematics education, at least not for most of the students.
- Learning the mentioned content has an insignificant contribution for attaining operational knowledge at a higher level, which is necessary if the students want to acquire complete, usable knowledge and skills.

Taking into consideration the previously mentioned, we believe that special attention should be given to the integration of the mathematics instruction, including inter-

subject integration, intra-subject integration and integration with the immediate environment. It is very important to realize the integration completely when attaining operational knowledge, which needs to be skillfully used by the teacher for the students to unobtrusively attain elementary structural knowledge. The latter is very important, if we have in mind the more evident need of procedural knowledge, initiated by the rapid technical – technological development and the undisputed fact that the students can attain the knowledge only through an integrated approach.

2. Examples of Integration of the instruction in Elementary Education

Further on, we will analyze several examples, which in our opinion will help improve the integration of mathematics instruction with other subjects and the environment.

Example 1: According to the second grade syllabus, the students should learn the directions left, right and straight, as well as the operations addition and subtraction of numbers to 20. However, neither in the syllabus nor in the existing textual didactic means efforts are made for their integration. The following task offers such an opportunity.

Help the girl get to the good mushrooms (Picture 1). The correct result will give you the right direction, for example, $7+6-8=5$. Afterwards, describe the movement of the girl by using the words straight, left, and right.

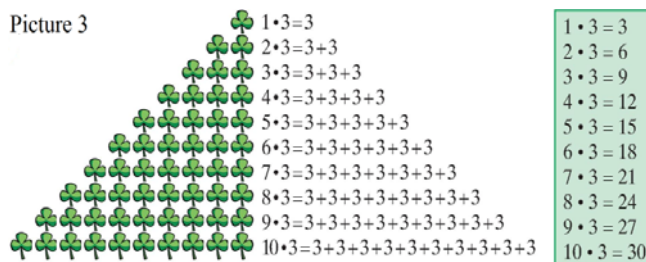


Example 2. According to the third grade syllabus the students should learn the multiplication table, which is most often illustrated by the use of a number axis. In natural sciences instruction, the students acquire knowledge related to the animals and plants in the environment they live in. In both cases, the knowledge is attained in a parallel way, i.e. there is no inter-subject integration and integration with the environment. For example, when learning the multiplication table with the number 3, we can do the following:

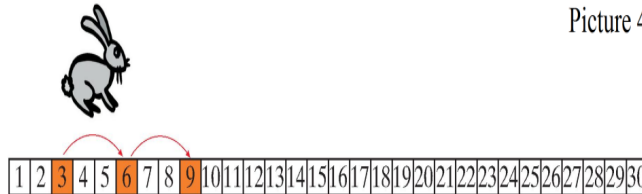
Picture

Picture 2

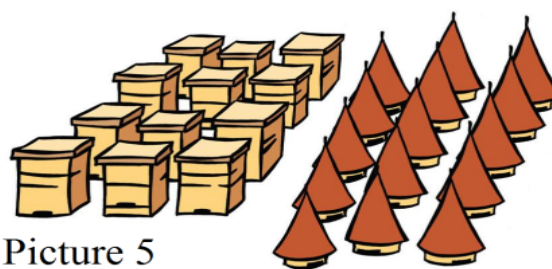
Picture 3



Picture 4



In Mr. Nikola's yard there are four rows with 3 wooden beehives in each row, and three rows with 5 skeps in each row (Picture 5). How many bee families are there in Mr. Nikola's yard?



Picture 5

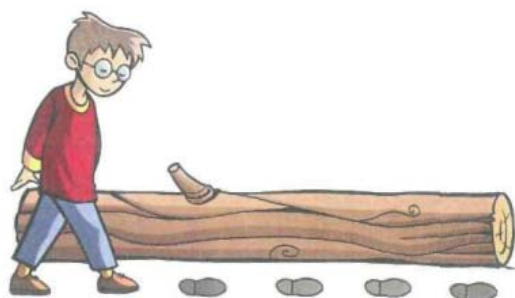
- Birds have two legs, bicycles and motorcycles have two wheels, and all mammals have two ears.
- Manufacturing three-legged chairs, fire pit spider grates, etc.
- Horses, goats, sheep, dogs, cats, deer, bears, lynx, wolves, etc. have four legs, and cars have four wheels.
- Starfish have five arms, there are five fingers on a hand, a basketball team has 5 players.
- Flies have six legs. A volleyball team has six players on the field.
- A handball team has seven players on the field.
- Octopuses have eight tentacles. Spiders have eight legs, etc.

Example 3: One of the objectives of mathematics instruction in elementary education is to teach the students the measurement units. Special attention is given to the units for measuring length (*m*, *cm*, *km* etc.). First, in a declarative way, the nonstandard measures of length are mentioned: steps, feet, hands etc. This is followed by learning the standard measurement units. In other words, almost all authors have not made a correlation of this content, which

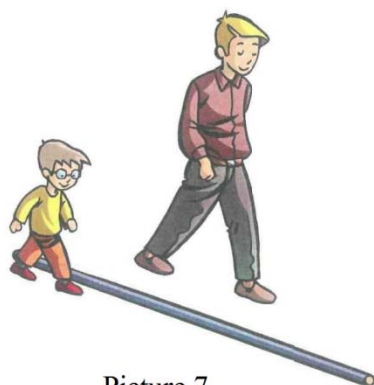
means that the units for measuring length are presented to the students in a dogmatic way. Experience shows that this approach does not provide cognitive learning of the units for measuring length, and as a result, the students do not understand the need to learn the standard measurement units. The following procedure regarding the nonstandard and standard units for measuring length will not only improve the inter-subject correlation but will also improve the cognitive component of the instructional process.

Learning the nonstandard units for measuring length may begin in the following way:

Bojan found a log. He made 5 steps from the beginning to the end of the log (Picture 6). The log is long 5 Bojan's steps. Continuing his walk in the park, Bojan came across Ilija and his father, who were measuring the length of a pipe with steps (Picture 7). Bojan noticed that the length of the pipe was 6 Ilija's steps, i.e. 3 steps of his father.

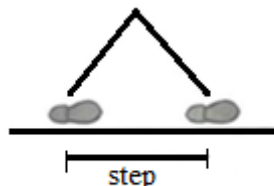


Picture 6



Picture 7

Afterwards, a discussion with the students starts about the measurement of the log and the pipe. The students are led to the conclusion that the measurement of length can be done by using steps. Finally, they are told that the step is a unit for measuring length (Picture 8).



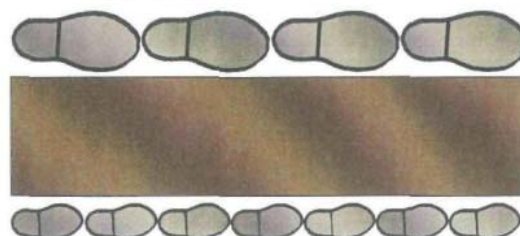
Picture 8

Later in the instruction, the students are led to the conclusion that in the case of the pipe, there were two different measurements and that in order to know how long the pipe really was, we need to know whose steps were used to

determine the result of the measurement. Then, we can discuss with the students how they measure the size of the goals when they play football, and after they explain that they do it by using steps (Picture 9), we repeat the procedure from the part of the lesson, when the step was learned as a nonstandard unit for measuring length, while presenting Pictures 10 and 11. The hand, finger and elbow, can also be used as nonstandard measurement units. When calculating the length with these units, it is important to stress whose step, foot, hand, finger or elbow was used to make the calculation.



Picture 9



Picture 10



foot
Picture 11

At the end of this part, before we start discussing the standard units for measuring length, we need to ask the following question: "If Ilija measures the pipe next year, will he get the same result? And why will he get a different result? After making conclusions, the teacher should explain to the students that the previously learned units for measuring length are nonstandard, and that in order to compare measured lengths in any given situation, we use standard units for measuring length.

In the previous examples, we presented ways to integrate different content when learning the units for measuring length, and as we can see in this case, a correlation with the everyday activities of most of the students has been established as well.

Example 4. One of the instructional objectives in elementary education is to learn the terms never, always and possibly, i.e. the terms impossible, certain and possible event. However, in [5], these terms are not elaborated at all, whereas in [4], an attempt has been made to learn them with an example including a die. Further on, we will make efforts

to demonstrate how these terms can be directly explained to the students by using the correlation with the immediate environment.

The teacher presents Picture 12 to the students and starts a discussion, asking them to describe it. The discussion is about two suns that have risen above the house. Naturally, at least several students will react to this, saying it is impossible. This will serve as an example for the term impossible event.



Picture 12

Bojan tosses a coin in the air. He tells his father it will be heads. Is Bojan right?



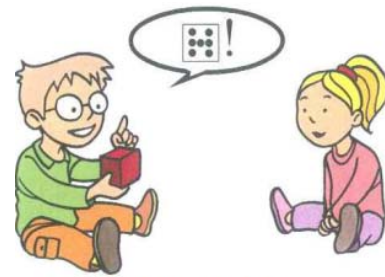
Picture 13

The teacher starts a discussion about Bojan's claim. Naturally, it is expected the students to have different opinions. When the timing is right, the teacher should form pairs of students and give each pair a coin, telling them to toss the coin several times in the air, just like Bojan, and record the results. After the students see that sometimes it is heads and sometimes tails, the teacher should explain that heads is possible, although it does not always happen.

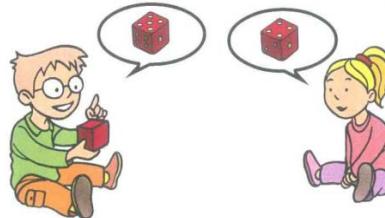
The explanation of a certain event may be done further on in this discussion. The teacher should ask the students to think about the following statement:

Bojan tells his father that if he tosses a coin, the result will be either heads or tails.

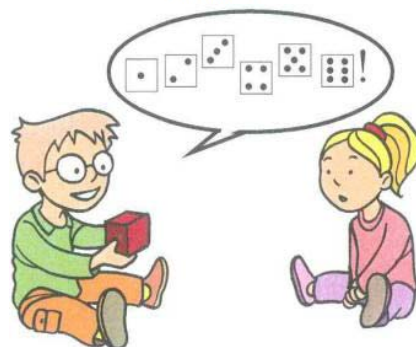
Also the teacher can use more complex examples further on, such as the die. Due to the age of the students, it would be beneficial if the discussion is accompanied by adequate illustrations (Pictures 14, 15 and 16).



Picture 14



Picture 15



Picture 16

In the previous examples we discussed ways of integration with the immediate environment in the introduction of the terms never, always and possibly. The same can be applied when learning content about the relations and the order of events. First we need to start with two events, and then we can use three or more events. Naturally, best results will be achieved if the content is discussed with examples familiar to the students, for example, events related to decorating a Christmas tree or a birthday party, followed by more complex situations.

3. Conclusion

We presented examples, which in our opinion can help improve the integration of a part of the mathematics instruction. Also, the previously illustrated examples and others similar to them enable the students, as early as elementary school, to acquire higher level of integrated knowledge and skills, which is primarily conditioned by the growing demand of complete and profound knowledge, needed to keep up with the dynamic civilization development, characteristic of the XXI century. How to achieve complete and uniform integration in the mathematics instruction? It is difficult to answer this question in only a few sentences. Nonetheless, this objective can be achieved by:

- Creating curricula and syllabi, which will stress the process-developing strategy in the planning of instruction. The integration of education (at all levels) will be a compulsory component of these new syllabi.

- Creating a new concept of textual didactic means (textbooks, manuals, collections etc.) according to the criterion for a complete integration of the instruction.
- Educating a new generation of teachers, who will be trained through integrated curricula and comprehensive methodological didactic mathematics education, which is not the case at present.
- Permanent training of the existing teaching staff, with the objective to train the staff to carry out uniform intra-subject and inter-subject integration of the mathematics instruction, and integration with the environment, as well.

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