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THE IMPORTANCE OF USING THE COMPUTER IN ACQUIRING MATHEMATICAL NOTIONS AT THE PRE-SCHOOL EDUCATION LEVEL

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***Abstract**: At the pre-school age, children get acquainted with the first mathematics notions on which the mathematics knowledge is going to be built later, throughout the school years' age. At this level, the focus is first and foremost placed on the formative aspect, envisaging the operating structures of thought, and less on the informative one, represented by the cognitive structures. From this point of view, one of the most important mathematics concepts introduced during pre-school age, is the arithmetic operation, as one of a decisive importance. On the base of the operation notion (addition or subtraction) is the idea of acting on reality, an action having as a consequence the transformation of an initial state into a final state. The computer, by its specific educational programs, has the capacity to illustrate this dynamics when one operates with iconic representations of the objects, an aspect facilitating the child's understanding of notions. Consequently, the present paper aims at arguing, from a double perspective, (mathematical and methodological) the advantages of computer integrating into the didactic strategy. Also, it tries to demonstrate the fact that every aspect that is perceived as a "weakness" of computer use in the kindergarten can be approached as a "strength" , as long as one knows the characteristic features of pre-school child, on the one hand, and the peculiar features of creating the mathematical notions with pre-school children, on the other hand.*

***Keywords:** pre-school student, computer, mathematical notion, didactic strategy, SWOT analysis*

I. THE PRESENTATION OF THE ISSUE

As any other component of the didactic strategy, the computer also presents advantages and drawbacks as far as its educational efficiency is concerned. In this respect, the computer use in the educational activities carried out in kindergarten is still a controversial problem for both parents and kindergarten teachers. Both educational factor scan easily express for and against opinions. However, only the deep knowledge of all the aspects characterizing the instruction-education process carried on at this level may constitute the basis of a correct decision in the matter. Education cannot be made at random, guided by "appearance". Even less so when one refers to younger ages, when informative, and mainly formative accumulations are very important and decisive for the child's further evolution. It is now that mistakes can be made that can never be corrected later on. As "all the aspects of the child's evolution are equally decisive for its further progress" (Culea, 2009, p.4) the kindergarten teacher has to appeal to all the means that are at her disposal for the maximum making use of each child's potential. Also, "it is necessary to continually improve the adequacy of the didactic strategies to the pre-school children's age features (motivation, interest, diversity, playful accent, socialization, preparation for life in general, but also for the next stage – school)" (Culea, 2009, p.4).

As regards mathematics, we must make clear that at the pre-school level, one cannot speak about it as an education discipline (school subject). At this stage, reality is approached in a holistic manner, identifying aspects that will later structure the school subjects. The arguments supporting the

presence of the mathematical component of knowledge built during the pre-school age are mostly of a formative nature. All the mathematical notions that the child encounters in kindergarten (set, number, arithmetical operation, geometrical shape, etc.) will be reviewed in the early primary forms. But what is important is the process by which these notions are created at the pre-school child's level. The child's abilities are developed within this process (perceptive, cognitive, volitional, motional, etc.) and this aspect constitutes the main aim of the instructive-educational activities specific to any experience field structuring the curriculum for the early education.

II. THE INVESTIGATION STEPS – RESULTS AND INTERPRETATIONS

The purpose of our research is to evince the advantages of the computer on which the kindergarten teacher should rely in carrying through the mathematical activities.

Thus, the hypothesis from which we started in conceiving this study is that *the computer is generally assessed as having positive effects in the carrying through of the mathematical activity in the kindergarten. There are, however, a lot of adverse opinions, which can be countered by the understanding of the role of the computer in the pre-school student's education, in general, and of the creation of the mathematical notions, in particular.*

In order to check the hypothesis, we completed a multi-criteria SWOT-type analysis regarding the computer use in the kindergarten activities with a mathematical content. This analysis had the following coordinates as criteria: *the purposes of the instruction-education activities carried through in kindergarten, the pre-school children's age features, the specificity of the mathematical notions introduced in kindergarten.* The data on which this analysis is grounded have been collected by several methods of research:

1.*The questionnaire,* applied to a sample of 40 kindergarten teachers from the city of Constanta. The questions in the questionnaire referred to *the computer use in the kindergarten activities with a mathematical content* . The situation is shown below:

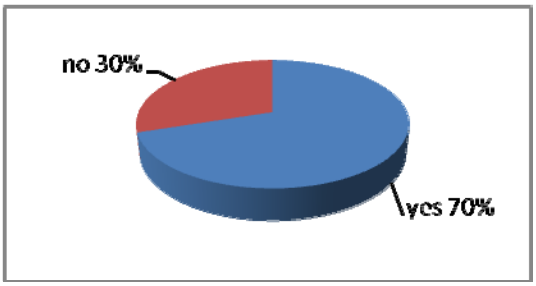

Figure 1. The distribution of the answers regarding the computer use in the activities with mathematical content

As regards the frequency of the use of this didactic means by the kindergarten teachers who answered affirmatively to the previous questions, the situation is shown in the diagram below:

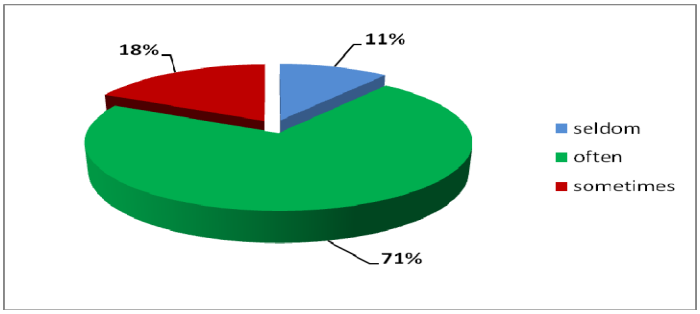

Figure 2. The frequency of the computer use in the mathematical activities

The following two items referred to the level of pre-school activity where the computer is used in the activities with a mathematical content. (figure II.3a), the nature of the mathematical content for which this didactic means is used respectively (figure II.3b). The distributions depend on the absolute frequencies.

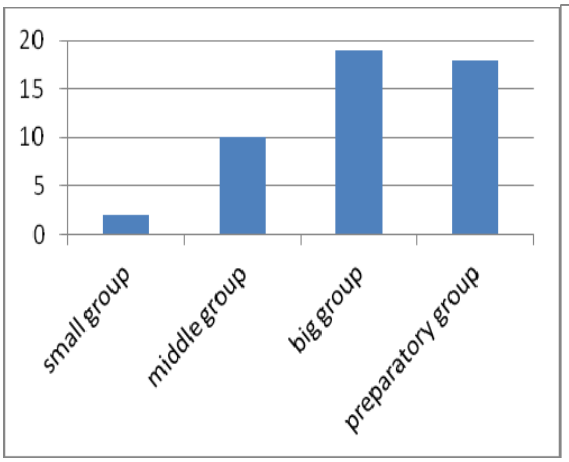

Figure 3a. The distribution of the frequencies of the computer use on pre-school age groups

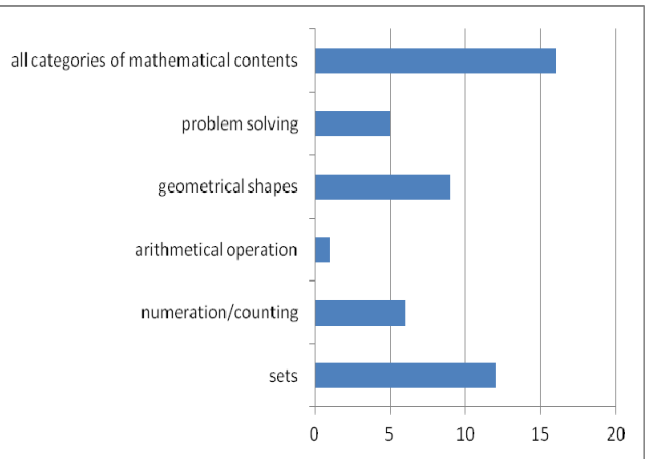

Figure 3b. The frequencies of the computer use according to the nature of the mathematical contents

One of the purposes of the inquiry based on the questionnaire was to evince the kindergarten teachers' *perceptions* of the role of the computer in the didactic activity with kindergarten children and especially to identify the kindergarten teachers' *convictions* regarding the *strengths* and the *weaknesses* of the computer assisted instruction.

Other methods used to check the hypothesis have been:

1. *The analysis of some educational softs* being used in kindergartens, both from the point of view of the correctness of the mathematical information and from the point of view of the manner of its presentation/didactic processing and its adapting to the exigencies of the pre-school age;

2. *The analysis of the curricular documents*, namely *The New curriculum* for early education, aiming at the objectives of the educational act at this level;

3. *The direct observation* of the activities with a mathematical content, achieved on the occasion of the attendance of the instruction-education kindergarten activities. A large part of these activities has given us the opportunity to note the manner of carrying through of the mathematical activities with the aid of the computer.

4. *The talk* with kindergarten teachers and methodologists on the topic of the computer use in the didactic activity.

The recorded results for any of the previously enumerated methods, completed with particular notes for kindergarten education of some "aspects of the computer use in the didactic activity" (Lebrun, 2007b, p. 51-52) are synthetically presented as follows, taking into account the dimensions of the grill of SWOT analysis: *Strengths, Weaknesses, Opportunities* and *Threats.*

Strengths

a) The motivating/stimulating effect that the computer has upon the child, due to its high degree of attractivity by "offering a diversified didactic material, accessible at any time, esthetic and adequate to the children's age features" (quotes from the answers of the questionnaire), "it is interactive", "it keeps the childen's attention alert a longer time", "it is preferred by children; it allows their mind and hands to play". Therefore, "children manifest a positive attitude to the learning activity", "they are more motivated, in the sense that they are more applied to the task solving"; in addition, "the immediate solution of the tasks and the positive appreciations on the positive results stimulate and motivate the child". The computer "is economical from the point of view of making up didactic material", offering an "attractive, dynamic and coloured" intuitive support, and also

"replacing the didactic material necessary to the mathematical activities". Also, during the carrying out of the didactic activities, "the virtual materials are easy to offer and withdraw, leaving time to childen for other games".

b) It has a formative-educational effect on children because it "allows for a better visual-motional and auditive coordination and also, a better interpretation of the message", "it favours the child's independent thinking", "it develops children's spirit of observation, promptitude in answer giving and self-assessment capability", "it stimulates curiosity, independence in task solving and in searching for solutions" and "develops personal qualities, logical thought and specific skills".

c) The computer use in kindergarten also prepares the pre-school child in what regards the development of digital competences, and the skill to use this didactic means in the process of instruction. Thus, "by the applications with a mathematical content, children can learn the computer using", "they get acquainted to modern technology".

d) Also, by the manner of presentation of the information, the computer *facilitates the process of understanding of the mathematical notions* ("by animated images") and *learning is more efficient* because "the main effect of technologies in the teaching-learning couple is manifested in new pedagogic media closer to the way in which the individual learns" (Lebrun, 2007a, p.175). The computer "offers a support to the child's concrete – intuitive thought", "it permits the visualization of the material (space positions, shapes, colours, classifications), as well as some actions (composition, decomposition, achieving one-to-one correspondences", thus facilitating notion understanding "in a far more rapid rhythm" and "the memorizing of knowledge", "it opens a new perspective for notion understanding", "it offers a more diversified range of knowledge" and "the possibility to diversify the manner of approaching the mathematical contents".

e) By the use of the computer "an integrated approach of contents is facilitated", which "constitutes itself a manner of curricular integrated manner of approach".

f) It supports the role of the kindergarten teacher as a "facilitator" of learning, she thus being "a resource person who facilitates the pre-school child's access to information" (Culea, 2009, p.6) and lesse of "a source of information".

g) The virtual material use is an advanced step on the way to abstractization, in the sense of the dematerialization of the objects with which one operates. This stage is a very important one in the creation of the mathematical notions. Consequently, with passing to handling iconic-figurative representations of the objects, this strategy is extremely useful, shifting attention from the material features of the objects to the actions one does on them, which is translated at the mental level by "operation"(see weakness, b)).

h) The computer can take over and render more efficient a part of the learning activities proposed in the work-outs, at least in two directions: it *illustrates the specific actions* of the various mathematical operations and *it allows the use of the mathematical symbols* translating these operations without the need of writing them. Thus, the computer solves a didactic problem supporting the getting rid of the obstacle in the understanding of the mathematical operations. We present below two examples of intuitive support for the subtraction operation 4-1:

Figure 4a. *Erroneous* intuitive support
(frequently met in work-outs
destined to pre-school children)

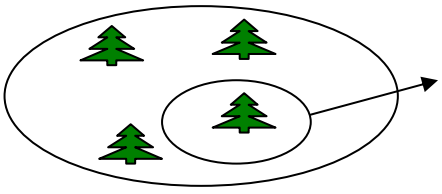

Figure 4b. *Correct* intuitive support
(illustrates the *eliminating* or deleting
a submultitude of a multitude of given objects)

Weaknesses

a) "The visual perception is privileged".

Remarks: At this age it is very important to develop the perceptive sensibility of all kinds (visual, auditive, tactile,…) because the pre-school child has an intuitive thinking, "not very sensitive to objective links, still closely tributary to the concrete sensorial character of reality" (Osterrieth,

p.109). Therefore, as the pre-school child "thinks what he sees and he does not surpass the data of perception", by appealing to the complex educative activities, the pre-school teacher has to aim at the discovery by the child of all the forms of manifestation of reality, to ensure to him a correct and complex perception of reality.

b) By using the computer, "the child does not handle the didactic material" and "does not verbalize the effected actions".

Remarks: These two aspects constitute the first two steps in the elaborating of the mathematical notions, a process that is synthetically presented in the figure below:

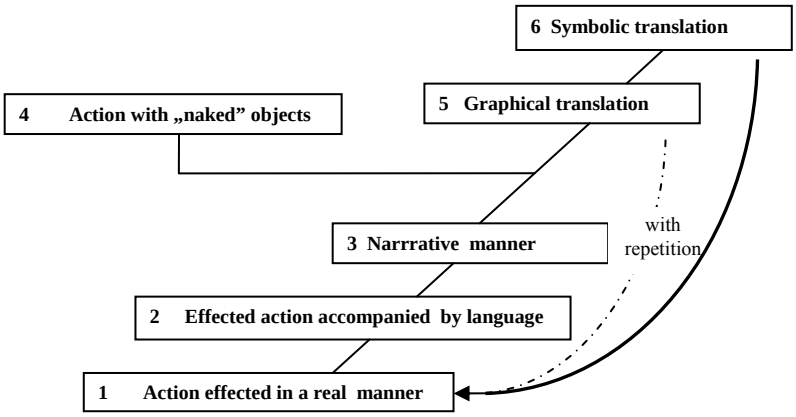

Figure 5. Stages in the construction of the mathematical notions (apud G. Mialaret, 1967, pp.30-39)

It is very important that the kindergarten teachers should know the particular features of this process and integrate the computer in the didactic strategy only when the efficiency is maximal, that is starting with the 4th stage. Thus, the lack of traditional didactic material from nature, "which are closer to the concrete", is compensated by the very consistent support offered by the operating with the virtual objects (dematerialized) in the abstractization of notions.

c) Another negative aspect of the computer use in the activities with pre-school children regards socialization: "children do not communicate with one another and do not socialize", it does not support the child's opening towards the other, in the stage of the diminishing of the egocentrism, when "the wishes of the partners really start to be taken into consideration" (Osterrieth, p. 106)

Remarks: At this stage, "the individual passes from an "each for himself" attitude and one of spectator of the others' activities to active social interactions even if they are sporadic and limited in the beginning. This evolution is evidently sustained by the continual melioration of the possibilities of verbal exchange", by "an ever more nuanced and efficient communication" (Osterrieth, p.104). "The child's thought at this age always gets installed more in the ordered system represented by the language spoken by his entourage, gaining due to it coherence, clarity, communicability" (Osterrieth, p. 108). Therefore, the presence of the computer must not affect this complex process in any way. Furthermore, by the educational situations in which the child is placed, his isolation must not be enforced "in a very different world from ours", due to "the egocentric structure of his thought and to the relative insufficiency of his verbal code" (Osterrieth, p. 112) but, on the contrary, he must be helped to structure gradually a very correct image about the surrounding reality. The computer must not steal this thirst for knowledge by exploration by invading his universe, but it must be used rationally.

d) The work with the computer "does not request motional complex activity and the direct work with the object".

Remarks: The muscles of the hand develop in a certain sense determined by the use of the mouse, but this is not the whole fine muscle structure necessary for writing.

e) A large part of the answers mentioning negative aspects of the computer use in the activities with pre-school children regarded health problems that it can create to children. But all of them can be avoided by observing the norms imposed in these respect.

Opportunities

a) The kindergarten teachers consider that they have "the training/education necessary for the computer use in the carrying out of the didactic activities" in a rate of 99% of the research sample.

b) The kindergarten teachers consider "beneficial the computer use in the carrying through of the nursery school mathematical activities" in a rate of 99% of the research sample.

c) "It is a didactic means preferred by the children", a reason for which they "learn notions more easily" and as a consequence, it enhances the efficiency of the didactic activities. Also, we can mention as an opportunity "the skill of children to work on computer from very young ages".

d) "The opening to the new" of the kindergarten teachers regarding didactic strategies.

e) The opportunities created by the New curriculum regarding the manner of carrying out kindergarten educational activities by work in small groups within ALA (Freely Chosen Activities).

f) "The existence of a diversified range of educational softs", but also the unlimited possibilities in conceiving and developing new specific programs, elaborated by mixed teams, in which both the age features of the pre-school children can be observed and of those regarding the correctness of the approach to the mathematical notions. In addition, beside individual games, collective games can be developed as well as common activities on the computer, taking into account that "starting with the age of 5, one speaks mostly of the associative game" (Osterrieth, p.105).

g) The necessity of the observing of the balance between the social activities and the individual ones proposed to the kindergarten child, because "if the contact with the others looks like an ingredient of the personality that is born, he has as much need for solitude, quiet and autonomous activity: working in his corner with his own treasures, the child makes important discoveries and learns to act without always being motivated or led by the others" (Osterrieth, p.108).

Threats

a) "The lack of providing the kindergartens with computers", a situation that a large number of kindergarten teachers in the research sample complain of, this being the main reason for which they do not use the computer in the mathematical activities.

b) "Large numbers of children in the pre-school children groups", and "the small number of computers does not allow for individual work, so "not all children can use the computer"

c) The kindergarten teachers' training both regarding the computer use and in constructing complex learning situations in which the computer should be optimally integrated. In didactics it is known that, in constructing a learning situation, "the computer itself superposed on the traditional norms of education cannot ameliorate the quality or output of education" (Lebrun, 2007a, p.181)

d) Some of the educational softs on the market "do not observe the exigencies imposed by a high quality didactic material" (it refers mainly, beside esthetic faults, to faults regarding the scientific correctness of the mathematical notions).

e) The New curriculum for early education does not explicitly provide the integration of the computer in the assembly of the didactic strategies.

f) An important aspect concerns "the impossibility to ensure the technical assistance (or very reduced possibilities) in the exploitation of computers" by the kindergarten teachers, namely the maintenance, of the specific equipment, the initiation of new educational programs, etc.

III. CONCLUSIONS

From the analysis above one can notice that in the opinion of the kindergarten teachers, the positive aspects related to the use of the computer are more numerous than the negative ones, which can be diminished if it is used "when, how and how much it ought to be used". Consequently, if one knows, on the one hand, the features of the educational context at the pre-school age, and on the other hand, the formative valences that the use of the computer can offer, then it can constitute a very efficient didactic means of constructing the mathematical notions. Therefore, the necessity of the inclusion of the instruction assisted by the computers is imposed in the economy of the didactic strategies in a complementary perspective. For this, it is necessary to identify those dimensions of the educational process for which the traditional strategies prove to be unsatisfactory and to make this

process efficient by introducing modern means. The computer will successfully take over the responsibility of this efficiency rise.

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