

Requirements to Resource Lesson on Mathematics with ICT and Domination of Pupil's Perception Modality

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Abstract

In the present article the leading idea of innovative training in mathematics is actualized. It consists in the following ideas: effective management of informative activity of students in teaching mathematics can be reached by the identification of pupil's dominating perception modality. Further design of technological founding procedures and constructs in the development of mathematical activity should be adequate to personal preferences. The technique of resource lessons on the basis of visual modeling and a support of pupil's dominating perception modality in teaching mathematics are realized.

Key words: perception modality, teaching mathematics, visual modeling, resource lesson

Introduction

Many known psychologists remark on the importance of individual distinctions of trainees in perception of subject information and need of content selection of education for the maximum updating of personal preferences in subject development (Brunner, 1962, Shadrikov, 2009, Vekker, 1964 and, etc.). In this direction the special role belongs to mathematics as to a subject having the greatest impact on efficiency of manifestation and functioning of pupil's perception modalities of subject information (*sign and symbolical, visual and geometrical, verbal and concrete activity*). Therefore *the leading idea* of innovative teaching in mathematics consists in the following: effective management of informative activity of trainees in teaching mathematics is reached as an identification of pupil's dominating perception modality and design of technological founding procedures and constructs in development of mathematical activity which are adequate to personal preferences.

Thus the sensitiveness of functional (operational) manifestation and development of pupil's dominating modality in their research activity conducts to success and productivity of mathematical knowledge development and activity. The connection of this idea with the organization of mathematics resource interaction with humanitarian and natural-science subjects on the basis of mathematical modeling creates new opportunities for cultures dialogue and personal development of pupils. Thus growth of educational motivation and success in mathematics development against the active acquaintance to its role in socialization of the personality in the modern world is expected. If the teacher shows thus readiness for innovative activity (understanding as an integrative unity of personal qualities and experience of the teacher, the directed on successful and creative solution of pedagogical tasks with a support on innovations in design of educational and training activity) in the conditions of the motivated and professional relation to problem solving of an individualization of pupil's personal preferences in mathematics development, it can really lead to formation of also individual style of teacher's pedagogical activity.

Methodology, Methods and Pupils Activities

At the beginning of the preparatory period the teacher carried out diagnostics of perception modalities and identification of pupil's dominating perception modality for 17 persons. The test consists from 40 questions with alternative answers (yes, no) concerns with various life situations were offered to each pupil (Smirnov, 2012). Uniform distribution on 4 perception modalities was revealed. Thus, there was an opportunity to develop 4 types of detailed designs for small groups of pupils united on dominating modality of perception. Detailed designs and their research activity are presented in Table 2.

Among components of anticipative activity of pupils during the preparatory period before carrying out a resource lesson it is necessary to call: home solution of verbal task by visual modeling, definition of small group structure and the distribution of social roles, definition of computer support of problem solving, updating of mathematical and natural-science knowledge and methods. The teacher prepares instructions for implementation of projects by pupils and an acquaintance of pupils with planning of research activity and organizes work stages of the project. The resource lesson was chosen as the main form of design activity. *Resource lesson* is a form of integrative activity of pupils under managing of the teacher for the development of educational activity on the basis of possible volume of additional learning information from other subjects, ways and means of informative activity promoting to personal development of pupils and the success of pedagogical tasks solving. The main method and the mechanism of updating of pupil's dominating perception modality is *visual modeling* of real situations, the phenomena and procedures.

The technology of visual modeling allows stimulating with various levels and duration of mental processes organization, including reflexive and motivational processes (Smirnov, 1997). The model has to reflect adequately the main lines of pupil's research activity and has to be described by mathematically; besides, it is necessary to consider a role of each element of defining structure, its functions and the characteristic. Using system approach, at research of visual modeling in teaching mathematics it is necessary to reveal structure of this process as it and has to be formalized on model creation of pupil's informative activity. Studying of this structure is impossible without the knowledge of educational process specifics and the features of application technique of visual teaching means and types, without the using of practical experience of approaches available in education. After studying of an oriented basis and structure of visual modeling it is necessary to design the system of the organization and management of pupil's research activity in conditions of a reflection and collaboration in small groups.

Therefore the problem of such process organization of teaching mathematics when the representations arising in thinking of pupils, reflect the main, essential, key parties of subjects, the phenomena and processes, including by means of adequate modeling of mathematical knowledge is actualized. The formation of these basic qualities of object perception (perceptual model) also represents an essence of process of visual modeling. Such approach of "apriori" assumes of modeling of object perception with a support on neurophysiologic mechanisms of memory, regularity of perception, mental opportunities and affective conditions of the personality. Thus the special importance is gained by the models fixing procedure of mathematical actions in research activity at creation of adequate conditions of perception. Such *pedagogical conditions* accompanying the process of visual modeling, can be: design of transitions of sign systems (symbolical, visual and geometrical, verbal, tactile -kinesthetic and concrete activity), the existence of level and hierarchical structures of considered models, variability of approaches and integration of sign structures, updating of levels of assimilation and complexity of mathematical objects and procedures, the activation of mental processes of different level and a modality. Identification the essence of each component of visual modeling in teaching mathematics assumes the search, knowledge and disclosure of regularities of its effective functioning, the creation of conditions for comfortable joint activity of the teacher and pupils, receiving diagnosed adequate results of internal actions of pupils.

Components of joint activities in teaching mathematics:

- *data collection and development of diagnostic techniques packages for measurement of pupil's dynamics development of personal processes* in cognitive and affective areas, in the definition of pupil's dominating perception modality both statistical and qualitative methods;
- *series selection of natural-science and humanitarian tasks* , possessing the information saturation of methods and receptions of decisions. Updating of pupil's perception modalities , bearing a positive motivational charge of mathematical modeling and using of mathematic resources, demanding of reasonable ICT - support in expansion and presentation of problem solving, pilot study of data allowing during in active social interaction (Smirnov, 2002);
- *possibility of intellectual operations development* (modeling, understanding, forecasting, decision-making, etc.) during realization of problem solving and transitions of sign systems, as well as the resource support of expressiveness degree updating of mental actions and pupil's perception modalities resulting in success of educational activity;

- ensuring *integration of mathematical, natural-science, humanitarian and information knowledge* on the basis of visual modeling during pupil's research activities. It should be realized during the solution of text tasks reflecting applied aspects of mathematical knowledge and processes (phenomena) in real life, and conducting to growth of pupil's mathematical competence;
- statement the clearness of diagnostic goals, design and realization of founding procedures stages of personality experience by the principle of "organic integrity" at development and generalization of substantial constructs and modeling. It should be realized against an adequacy of formed expressiveness of perception modalities and generalization of operations (Smirnov, 2012).

Lesson Planning for Mathematics 6th Grade

Lesson type: Lesson-research of real life by visual modeling

The purpose: Generalization and ordering of knowledge and thinking activities using the domination of pupil's perception modality on a subject «Solving of verbal tasks».

Problems:

The educational: to master stages of visual models construction of problem solving, to check up the integration of mathematical knowledge, universal skills and research activity of pupils on a subject; to fix the basic concepts and rules, and also methods of solving for different verbal tasks.

Explicating: development of educational skills of work with the textbook and with a distributing material, development of mathematical speech, self-checking, a self-estimation, the creative ratio to matter, development of universal educational operations, abilities to analyze, modeling, generalize and make conclusions, development of communicative abilities, graphic culture of pupils, motivation to learning mathematics. *The personal:* education of responsibility and goodwill, ability of calligraphy, ability to work in groups.

The lesson plan:

1. Organization of lesson's beginning and statement of the lessons purposes (5 minutes).
2. Motivation and actualization of research activities – warming up (10 minutes).
3. Preparing of pupils to experimental work and planning of solving verbal tasks (10 minutes).
4. Research activities in small groups divided on pupil's types of perception (25 minutes).
5. Assessment stage and Presentation of group results (25 minutes)
6. Reflection and lesson summarizing (5 minutes) Total: 80 minutes.

Conclusion

The conducted research have showed the relevance of chosen subject and partially confirmed the hypothesis of practice-oriented approach importance in teaching mathematics in interaction of subjects. It was realized on the basis of updating of pupil's dominating perception modalities (sign and symbolical, visual and graphic, verbal and concrete activity). The research of innovative approach in visual modeling and the integration of mathematical, natural-science (humanitarian) and information concepts, phenomena and processes, the activation of motivational and informative substructures led to positive changes in personal and subject development in teaching mathematics both on mathematics, and in natural-science subjects. Design of resource lessons as the main form of subject interaction realization showed the efficiency and opportunity for further research of their influence on pupil's development of intellectual operations and universal educational actions. The development of resource lessons cycles in teaching mathematics and profound justification of technological innovations on the basis of pupil's dominating perception modalities are recommended.

References

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Table 1: Requirements to Resource Lesson on Mathematics

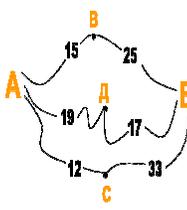
<i>Components of Educational Design</i>	<i>Content of Components</i>
Features:	Educational activity on a high level of complexity adequating of perception modality; Dialogue, discussions and criticism in behavior and thinking of pupils; The decision of tasks in small groups; Using of creative tasks and problem solving of a different level of content and perception; The reflection analysis, scientific thinking, information interchange, presentation of results; Estimated activity of pupils in subjects problem solving
Main purposes:	Interrelation and estimation of mathematical methods efficiency joint ICT for the subject tasks decision ; Activity of pupils during development of the maintenance (discussion in small groups, presentation of results, information interchange, estimated activity); Visual modeling of the phenomena and processes; Activization of motivations on forming of real interests during educational activity: motivation of achievement of the result, motivation of self-realization (through work in small groups), motivation of integration of knowledge and activity (through mutual penetration and comparison of mathematical methods)
Methodological ideas:	Visual modeling in educational activity; Training on a high level of complexity; Domination of perception modality and scientific thinking; Reflection and internal plan of pupils actions; The organization of work in small groups
Activity of pupils:	Activization of subject knowledge of the last years on the basis of integration of a mathematical and ICT resource, participation in discussion and setting of educational tasks; Distribution of social roles in small group, an individualization of educational activity (planning, forecasting, acceptance of decisions, selection of the data and modeling, managing of ICT resources, registration of results; Visual modeling, scientific thinking and presentation of research results and reflection
Motivation:	– Cognitive interest determines the activization of achievement motives : <ul style="list-style-type: none"> • presence of adequate result in practical activities; • construction of mathematical model of process or the phenomenon; • ability to consolidation (in thinking of the pupil and activity) the initial data for the decision of a problem; – Social motives are actualized by dialogue and interaction in small group: <ul style="list-style-type: none"> • a choice of a social role; • social tests and search positive (internal and external) results of dialogue; • expansion and development of activity in a direction of self-realization of the person

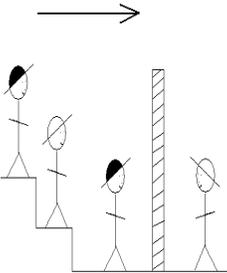
Table 2: Methods and pupil's activity

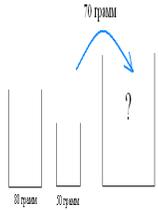
Stages	Time	Basic abilities	Resources	Activity of the teacher	Activity of pupils	Communicative activity	Reflection and assessment
Motivation and actualization	15 minutes	Ability of modelling, the analysis, develop of communicative abilities, graphic culture of pupils	Projector (the problem is visible on the screen)	1. Salutatory words. 2.«We solved a considerable quantity of problems on different themes: on equation compiling, on compiling of a proportion, a problem on answer determination on drawing, logic problems on a correct reasoning, on search of errors etc. Generalization of knowledge in respect of problem's solving will be the purpose of our lesson. We will consider the basic approach for understanding of essence and correct solving of various mathematical problems. A theme of our lesson: «Visual modelling in solving of verbal tasks».	Welcome the teacher. Listening. Open a writing-book, write down a lesson subject.	Rushing of pupils to take active part in a problem solving, to discover the right answer	Communication with pupils, setting problems, We inspect the ability to solve non-standard problems; Pupils also trace this ability.
				We suggest pupils to solve the following problem: «the Cuckoo clock makes 6 blows for 5 seconds. During the first blow include a stop watch. For what time hours will beat off 12 blows? »	Argue by itself, do entries to writing-books, drawing. (The certain algorithm of a solution is not found now). If there is a solution, the pupils sound it for all class.		

Stages	Time	Basic abilities	Resources	Activity of the teacher	Activity of pupils	Communicative activity	Reflection and assessment
Preparing pupils to study of new material	10 minutes	Ability of work with visual resources (a board, slides), ability to model, render concrete, Development of mathematical speech, the creative ratio to matter, graphic culture of pupils	Standard (a board, slides on the screen).	<p>Together with pupils we start to argue over the offered problem. Pupils write down the plan of reasoning and a solution in a writing-book.</p> <p>1. The problem analysis (reality of situation, exposition of the matter).</p> <p>The purpose of the given stage consists in that pupils "have accepted" this problem, i.e. have understood its sense, having made its purpose of the activity (thinking planning). Orally we argue with pupils concerning a situation in a problem. It is important, that all have understood that only even during 1 blow of hours the stop watch joins, i.e. 1 blow has happened on 0th second.</p>	<p>In a writing-book note:</p> <p>Algorithm of problem solving: The analysis of a problem and attempts to find the answer. Understanding of complexity and nonstandard happening situation, necessity of problem visualization.</p>	Rushing to improve the abilities, rushing to take active part in speech activity	Activity of participation of pupils in a problem solving, their independence, and the offered ideas are traced.
				<p>The model is working out.</p> <p>Important point is the construction of graphic and mathematical model, and also clearing up of a strategy of problem solving. We build schematically blows of hours, marking their points.</p>	<p>Note: The model is working out. The representation of conceptual model:</p>  <p>Knowing that 6 hours are punched for 5 seconds, we mark the given fact a curve in drawing, we sign «5 sec» (thereby creating of mathematical model):</p> 		
				<p>Problem solving (process and stages). We suggest pupils to make it clear; the pause between blows is what the time lasts.</p> <p>- How many such pauses are there between 1 and 12 blow of hours?</p>	<p>Problem solving (process and stages). Calculate: 5 sec: 5 pauses = 1 (sec) – time of one pause</p> <p>Answer: «11 pauses».</p> <p>11 pauses * 1 sec = 11 (sec) – in this time will strike hours 12 times.</p>		

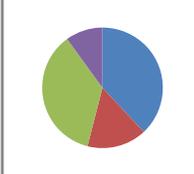
Stages	Time	Basic abilities	Resources	Activity of the teacher	Activity of pupils	Communicative activity	Reflection and assessment								
Actualization of stages and knowledge				<p>4. Problem solving (results) and the outcome analysis. At the given stage principal ideas of a solution and its essential moments are selected. Shortages of a solution become clear and search of more rational solution is made. The second variant of a solution of the same problem is offered to pupils to consider houses. For a solution it is possible to make the table:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Blows of hours</td> <td>1</td> <td>...</td> <td>1 2</td> </tr> <tr> <td>Time (sec)</td> <td>0</td> <td>...</td> <td>?</td> </tr> </table>	Blows of hours	1	...	1 2	Time (sec)	0	...	?	Note: Problem solving (results) and the outcome analysis.		
	Blows of hours	1	...	1 2											
Time (sec)	0	...	?												
				<p>After problem analysis suggested to solve one more, similar given (for fastening): «Hours beat 12 blows. At the moment of the first blow include a stop watch. On 6th second there is 6th blow. On what second will there be 12th blow? » (It is necessary to consider that the offered algorithm can change in the conditions of a specific target, some points can fall out). «We often should solve problems, and not only at mathematics lessons, but also in real life. Various situations rise before us, but we need to be able to solve them. Now you are divided onto 4 groups and each of you I will present a problem which you can face at any moment in life. It is necessary for you, operating the offered algorithm, to solve these problems».</p>	<p>Similarly, moving on basic points of the algorithm set forth above pupils solve a problem. The answer: 13, 2 seconds.</p>										

Stages	Time	Basic abilities	Resources	Activity of the teacher	Activity of pupils	Communicative activity	Reflection and assessment
Research activity in small groups	25 minutes	Ability to work with distributing material, the computer, development of universal educational operations, self checking, the creative ratio to matter abilities to model, do conclusions, development of graphic culture of pupils, abilities to work by analogy.	Distributing material, instructions for each group, noted algorithm of absorption of a problem; The computer with the program for check of correctness of problem solving.	Having noted and having acquired the plan of problem solving, pupils are divided into groups. Separation on groups happens long before this lesson. The teacher had performed a technique on definition of leading modality of perception which became a starting point at the given division of a class.	In total pupils are divided into 4 groups on dominating type of perception modality: 1 – sign-symbolic; 2 – verbal; 3 – concrete activities; 4 – graphic. Each group receives the problem.	Rushing to take active part in group work, in a task in view solution; to improve the communicative abilities; to be engaged in creative activity; to exhibit initiative and consciousness at arguing.	The teacher inspects a course of a solution of problems, approaching to each group, gives valuable instructions, corrects if necessary. Pupils trace correctness of a solution by comparison of solution stages with offered algorithm.
				<p>Problem of Group 1. «The bicyclist is going to pass from point A to point E in which conduct 3 roads: through point B, C and D. The distance between points is the following: A-B 15 km, B-E 25 km, A-D 19 km, D-E 17 km, A-C 12 km, C-E 23 km. It is known that if we go through B the average velocity is 16 km/h if through D – 18 km/h if through C – that of 20 km/h. The bicyclist chooses the route so that to reach point E in the least time. How many hours will he stay in a way? »</p>	<p>Group 1 solves the problem. At first it is necessary to draw</p>  <p>event model: Then we discover distance from A to E if we move: Through B – 40 km; Through D – 36 km; Through C – 45 km. Knowing that time (t) = distance (s) / velocity (v), we discover that least time (2 hours) will be expended if we go through point D. Also it is possible to check up a solution of the given problem on the computer through the prepared program for a solution of given problem.</p>		

Stages	Time	Basic abilities	Resources	Activity of the teacher	Activity of pupils	Communicative activity	Reflection and assessment
R Research activity in small groups				<p>Problem of Group 2. «In offered drawing we have 4 persons, two of them in black hats and two - in white. The partition is a wall through which it is seen nothing. From left to right: 1st person sees 2nd and 3rd, 2nd sees 3rd, 3rd sees a wall, 4th generally sees nothing. They know, how they stand, know that there are 2 black and 2 white hats. Each of them asks: whether "you know, in what hat are you ? »It is supposed two variants of the answer: "Yes, I know, I in... hat" or "Is not known. I do not know «Who can answer the first, in what hat he is?</p> 	<p>Group 2 solves the problem. The obvious model is already offered, pupils need to analyze it only. The method of solution consists in reasoning that each of characters has answered, seeing before himself other person in a hat or a wall. 1st, having seen before himself people in a white and black hat, and also a wall, will answer that he does not know in what hat since he is there were 2 black and 2 white hats. 2nd, seeing before himself the person in a black hat, a wall, and also having heard the answer of 1st participant will understand that if 1st saw before himself two in black hats, he there and then would answer that he has a white but since he had not told, means sees before himself one person in white and one in a black hat and since 3rd in black, means I (2nd) in the white.</p>		

Stages	Time	Basic abilities	Resources	Activity of the teacher	Activity of pupils	Communicative activity	Reflection and assessment
<p>Research activity in small groups</p>				<p>Problem of Group 3. «There are two glasses capacity of 80 grammas and 50 grammas. How to gather from under the crane exactly 70 grammas of water in the vessel? »</p>	<p>Solution of Group 3. At first, it is necessary to create model:</p>  <p>If we can pour 20g into the vessel, so will be opportunity to gather the necessary quantity of water, having 50g glass. Let's fill at first 50g glass and then pour out it in 80g. We will repeat the same operation. In 50-g glass remains 20 g of water; we will pour out it in our vessel. We will fill once again 50g glass and again we will pour out in the vessel. So it comprises exactly 70g of water.</p>		

Stages	Time	Basic abilities	Resources	Activity of the teacher	Activity of pupils	Communicative activity	Reflection and assessment
Research activity in small groups				<p>Problem of Group 4. To construct a circular chart of distribution of square of a land if it is known that wood occupies 38 % of a land, steppe – 16 %, deserts – 36 %, an arable land – 10 %.</p>	<p>Solution of Group 4. Having analyzed and having understood the purpose facing the group, we create diagrammed model (we draw a circle). But what landscape needs to be returned which sector? All land is 100 %; on the diagram it is 360°. Means to represent the sector corresponding to square of wood, it is necessary $38/100 \cdot 360 = 136,80$. Similarly: steppe – 57, 60; deserts – 129, 60; an arable land – 36°. We represent on the diagram corresponding sectors.</p>		
				<p>We suggest pupils to check up the solution on the computer in the program ms excel. In advance prepared template is necessary to introduce only percentage relation</p>	<p>Check a solution on the computer.</p>		



Stages	Time	Basic abilities	Resources	Activity of the teacher	Activity of pupils	Communicative activity	Reflection and assessment
Presentation of groups results	25 minutes	Development of mathematical speech, graphic culture of pupils, ability of modelling, a self-estimation. Ability to work in small groups.	Board, chalk. The computer for a solution featuring. A requisite for a performance of a solution of problems in 2 and 3 groups.	At the given stage the teacher suggests to present solutions of all offered problems on a board. From each group there is one representative and tells, does necessary entries, uncovering a task in view solution. After a mathematical solution of the given problems the small performance is offered.	Representatives of groups go out and note a problem solving. Remaining pupils note a solution in a writing-book. Group 1 during performance is authorized to show outcome of a solution not only on a board, but also on the computer through the connected projector. Group 2 is working with a problem about hats, dramatizes an event in a problem. Group 3 is working with a problem on transfusion, 2 glasses of the corresponding capacity and bank in which it is necessary to gather 70g of water are offered. The representative of a groups shows, what operations need to be made. Group 4 during performance is authorized to show outcome of a solution not only on a board, but also on the computer through the connected projector.	Rushing to take active part in speech dialogue, arguing on the discovered solutions, and also to be engaged in creative activity. Desire to estimate the communicative abilities.	The offered solutions are inspected and estimated. Pupils pass an opinion, thoughts of the given solution, and other way of determination of the answer.