

MicroWorlds Potential for Creating Educational Software for School

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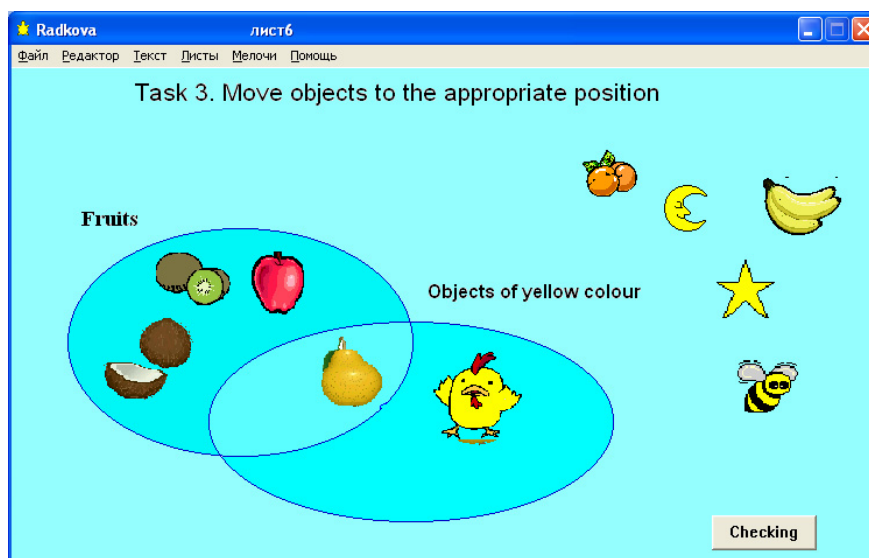
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Abstract

In the department of Elementary education Karelian State Pedagogical University within the framework of specialization "Teacher of mathematics and informatics into 1 - 6 classes" the two-level process of instruction in the Logo programming language is being carried out. During the first stage (in the special course "Basics of Programming in logo Language") the bases of Logo programming language are studied. The purpose of the second special course - "Information and communication technologies in elementary education" - is forming the skills of would-be teachers in the field of design and developing the complex designs - educational software for primary school (ES) with the use of Logo programming language. In the process of creation of projects the students become acquainted with the technology of the creation of projects, they generalize and systematize knowledge, obtained earlier:

- the means of the conclusion of information, organization of dialogue, change of personnel, etc are revealed;
- compare the different methods of obtaining of one and the same result;
- select the optimum method of achievement of the objective as a result of search and research activity students they create individual projects.

In the article the ideas and the practical decisions of the students, who found embodiment in the finished projects from mathematics, informatics, biology and to other subjects of the course of our long-standing work on the course, are generalized. The formulated author's theses are illustrated by the fragments of the programs, developed by students (example of the assessment frame from the program on the informatics).



Keywords

Educational Software; Primary School; MicroWorlds; Technology of Educational Software creating; Would-be informatics teachers

About the course “Information and communication technologies in Elementary education”

In the department of elementary education Karelian State Pedagogical University within the framework of specialization the "teacher of mathematics and information theory into 1 - 6 classes" is achieved the two-level process of instruction in the Logo programming language is being carried out. During the first stage (in the special course "Basics of Programming in Logo Language") the bases of Logo programming language are studied. The purpose of the second specialty course - "Information and communication technologies in elementary education" - it appears formation the future teachers of skills have in the region of design and developing the complex designs - educational software for primary school (ES) with the use of Logo programming language. According to specialists Logo programming language is the training language of programming. However, in our opinion, it contains great potential, which makes it possible to use it as the professional language of programming. In particular the means of the Logo language prove to be effective with writing of pedagogical software, and first of all, training programs for the students of elementary school and 5 - 6 classes. Why have we chosen pedagogical software? This is caused by the following circumstances:

1. ES for the elementary school must have the specific special features: comfortable interface, convenient navigation, the high degree of the clarity of training material, and for the students to desirably ensure the possibility of fulfilling various actions. All these special features can be successfully realized by the means of the language of Log (in particular, in the Micro Worlds environment).
2. In order to achieve the desired result and to create a good project, it is necessary for the students to implement search activity and to manifest and to develop systematic skills: to analyze, to compare, to assume optimal solutions.
3. Our students - the future teachers of information theory in the elementary school - with the development PPS already project the educational environment, in which will be used their program. Sometimes students succeed themselves in using a result of their training activity during the pedagogical practice on the lessons in the school.
4. On the object lessons, where the programs, written in the language of Log, are used, children work in by familiar by it to environment, which makes their activity more useful more comfortable and more interesting. However, the possibility of organizing the integrated lessons on the information theory and the corresponding object is created for the teachers. In the process of studying the course the students become acquainted with the requirements for pedagogical software for 1 - 6 classes, with the types of pedagogical software and the stages of their development. Each student appears in two roles: methodologist on one of the training objects and the programmer. As the methodologist he studies particular topic on the selected subject area, selects the content and develops the scenario, on basis of which the algorithm and the program are created. In the process of the creation of projects the students become acquainted with the technology of the creation of projects, they generalize and systematize the knowledge, obtained during the study of the Logo language:
 - o they reveal the means of the conclusion of information, organization of dialogue, change of personnel, etc.
 - o compare the different methods of obtaining of one and the same result (for example, output to the screen of text or graphic object)
 - o select the optimum method of achievement of the objective (for example, program or tool house; programming one or other object or another and others.) All enumerated problems are discussed in the studies. As a result of search and research activity the students create individual projects. In the article the ideas and the practical decisions of the students, who found embodiment in the finished projects from mathematics, information theory, biology in the course of our long-standing work on the course "Information and communication technologies in

elementary education", are generalized. The formulated author's theses are illustrated by examples - frames from the programs, developed by students.

Educational Software for School

We view *educational software for school*¹ as an application created to realize particular educational tasks, having content of a definite school subject and being aimed at interaction with a schoolchild (1). The main ES purpose is utilizing in teaching process. According to educational tasks solved there are a few types of Educational Software:

- teaching programme
- training programme
- knowledge control programme (control or testing programme)
- computer textbooks
- computer taskbooks
- laboratory practice aids (Bashmakov & Bashmakov (2003))

In the present article we are going to overview only the first three ES types. Let us, above all define them.

Teaching software – Educational Software for basic training in one or a few units (topics) of a curriculum. Training is implemented by means of concentrating on small information units and providing feedback on every step.

Training software are modelled for repeating and securing schoolchildren's knowledge and skills. The child is provided with more or less wide *range of tasks* in a particular topic, whereas a constant control and assessment (in a "reply" form), aimed at educational skills correction is supplied.

Knowledge control computer system is aimed at defining a schoolchild's proficiency in a particular subject, course, unit or topic and his assessment, based on established skill requirements (Bashmakov & Bashmakov (2003)).

Most generally the process of ES elaboration may be viewed as a sequence of the following steps:

- development of a programme project, resulting in elaboration of a scenario
- a programme realization
- a programme expertise

An Educational Software scenario (project) is a detailed description of a purposeful child's interaction with the computer with the use of a natural language. A scenario is a sequence of frames linked together following each other. The following frame types can be defined: title, information, instruction, navigation (menu), control and frame - reply. Each frame represents the contents on the screen and leads to the next ones linked to it.

¹ Different term – educational computer tools (1).

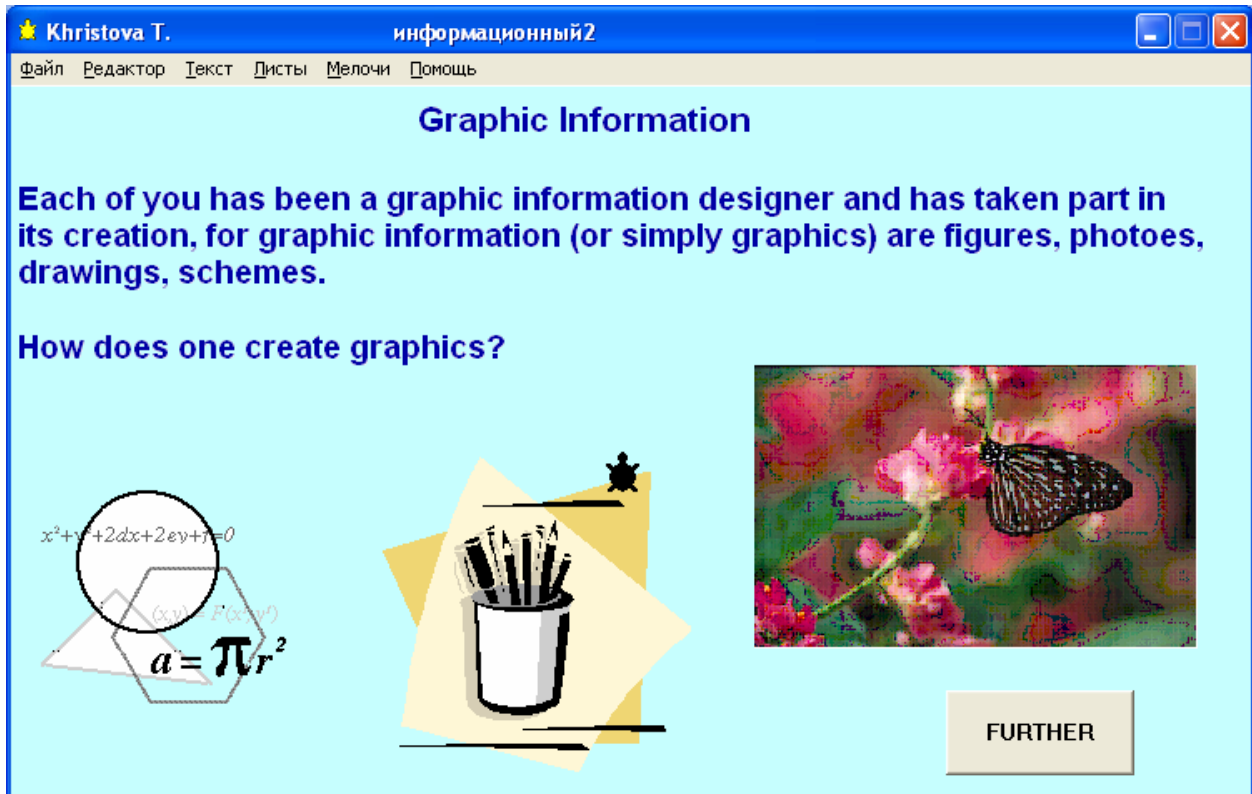


Figure 1. Sending and receiving common and private characters (style: Figure caption)

Structure of educational software for school

Educational software is elaborated on a scenario basis and, naturally, follows its logics. Each programme, in spite of its contents and purpose consists of necessary number of blocks (modules).

1. Screen output of information on the programme and authors.
2. Screen output of educational information (some new study information, tasks, exercises, questions, reference information, etc.)
3. Answer input
4. Check correctness of the given answer
5. Input of a reply – reaction to the quality of the answer given (message on correctness or mistake)
6. Assessment in control programmes

In the article the results of our research are being illustrated by the examples taken from the programmes created by the students. Below there are examples of frames taken from different programmes – educational, training and assessing. In the next part of the article ways of realization of every module by the Logo Language resources are to be analyzed.

Output of the information on the screen

While working with ES a schoolchild deals with information all the time – text, numbers, graphic objects, sound signals. Correlation of various types of information in the programme depends on the type of the programme, the subject, the topic, stage of studying process, school children's age and type of the Frame. Thus, in ES in local lore study graphic information (dynamic as well) will naturally prevail, and in software in the Russian and Foreign Language – text or audio information. Assessment programmes in any subject consist mainly of text and numerical data: tasks, exercises, questions.

Output of the information on the screen is actually carried out in all Frame types, however according to kinds of information to be output and ways of its output to the screen Title Frames, Assessment Frames and Frames-Replies may have a significant difference. (See Fig.1 for example)

Let us view various types of information for output on the screen and possible ways of creating it by means of Logo Language in MicroWorlds.

Text information

In Logo Language programmes text is put out on the special window (normally the text one), signal or dialogue one. The text window is known to be created in two ways: “manually”, with the help of the mouse or command **newtext**.

The text may be put out in two ways:

- with the use of integral text editor.
- by programming – (command print)

Text editing and processing is appropriately carried out with one of the following ways:

- with the use of the Text Editor commands
- with the use of programming (by using primitives of text processing)

In the process of ES elaboration the authors solve the problem of the way of text window creation and text output. If it is crucial that while implementing the programme the text is seen by the user, the programming way of text output is to be used. If a ready text-Frame is required, it is much more convenient to print it and process beforehand. While working at the programme it is often more interesting and convenient to see a message (reply, comment, assessment mark) not in the static text window, but in the signal window, which pop-up is accompanied with a sound. The announce command is used for this.

The signal window, which is put out by the command *inform*, is often used in Frames-Replies. In Assessment Frames another way of text output on the screen is used – command *question* and sensor *answer*. Command *question* opens the dialogue window, where the question (the input parameter of the programme) is printed and suggests to print the answer. After the answer has been put in, its text is saved in the sensor *answer*.

Graphic information

In ESS for Elementary school graphic information is most important – it allows to get educational principle of visual teaching, enforces motivation to study.

Ways of output of graphic information on the screen

1. Use of Graphic Editor for Bit-map Graphics
2. Programming (use of group of commands and sensors of the Logo Language, called the Turtle Graphics)
3. Import of graphic objects from files and the Internet.

Graphic Editor allows to create static objects and is most often used while making background and “non-processible” (not requiring manipulation, processing) objects in various programme Frames. *Programming* is convenient for elaboration of some graphic objects (for example, regular geometric figures), but mainly – for realization of dynamic graphics (creating simple moving objects and animation). Both of these ways allow merely put graphic objects out on the screen, i.e. make them visible, but, unfortunately, they do not let children operate with them, take some actions over them. One of the effective ways to represent graphic as well as text and numerical information on the screen – in order to manipulate them further – is the Turtle having the necessary form (picture, letter, word, number). We are going to scrutinize this way below, while analyzing ways of data input.

Organization of Dialogue

One of the ESS requirements is interactivity – the way of providing dialogue-like interaction between a child and the programme. The child should see (or hear) the task question or demand, enter the answer to it or solve the task and then wait for the system’s reply to the answer given. Control of comprehension is carried out at all stages of studying process, while introducing the new information as well as during revising, so means of feedback must be projected in all types of ESS. MicroWorlds environment offers significant opportunities for “schoolchild – computer” dialogue realization:

1. Creation of the procedure may be treated as the simplest means of dialogue realization. Body of the procedure may include reply to the answer, if the answer coincides with the procedure’s name.
2. Programming of objects (the Turtle, button, colour)
3. Working with the text window as the object
4. Command question and sensor answer. Command question opens the dialogue window, where the question (the input parameter of the programme) is printed and suggests to print the answer. After the answer has been put in, its text is saved in the sensor answer.

It is worth while providing conditions for forming skills to solve *various adequate* tasks with different objects in educational activity of young school students. Taking this into account the possibility to make different actions for choosing the correct answer without being restricted by the mouse click (as is often the case) should be provided in ES. Children’s answer input in ES for School may be realized by making various actions with text and graphic objects.

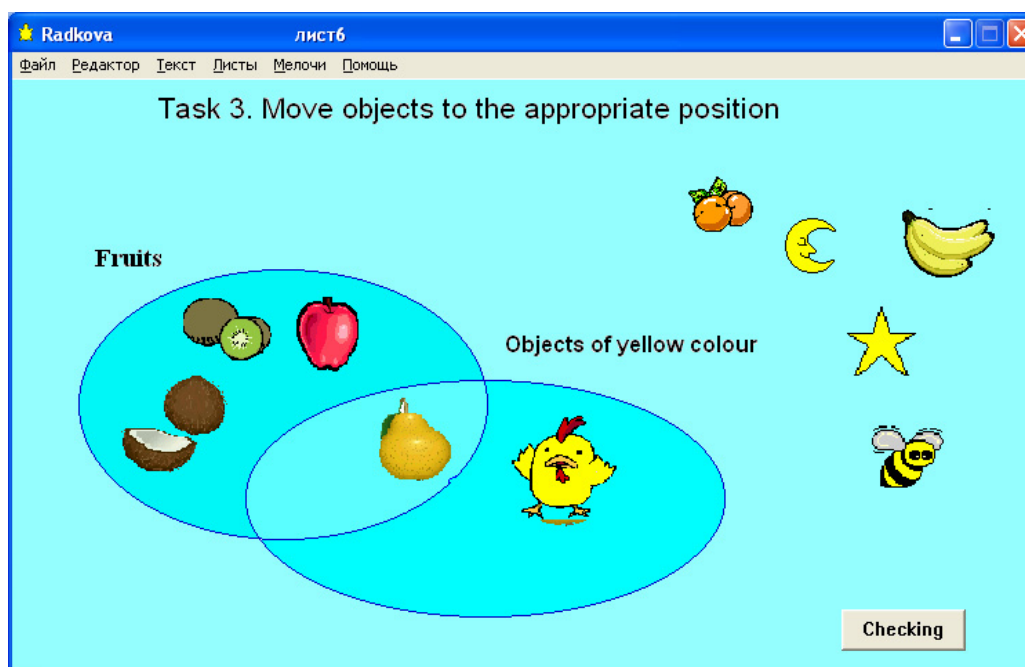


Figure 2. Assessment frame. The answer is put in by means moving the Turtles. After the answer is put in a click on the Check button. Assessment is carried out by comparing colour of the margin under the active Turtle with the sample number, corresponding with the real colour (50, 120, 10)

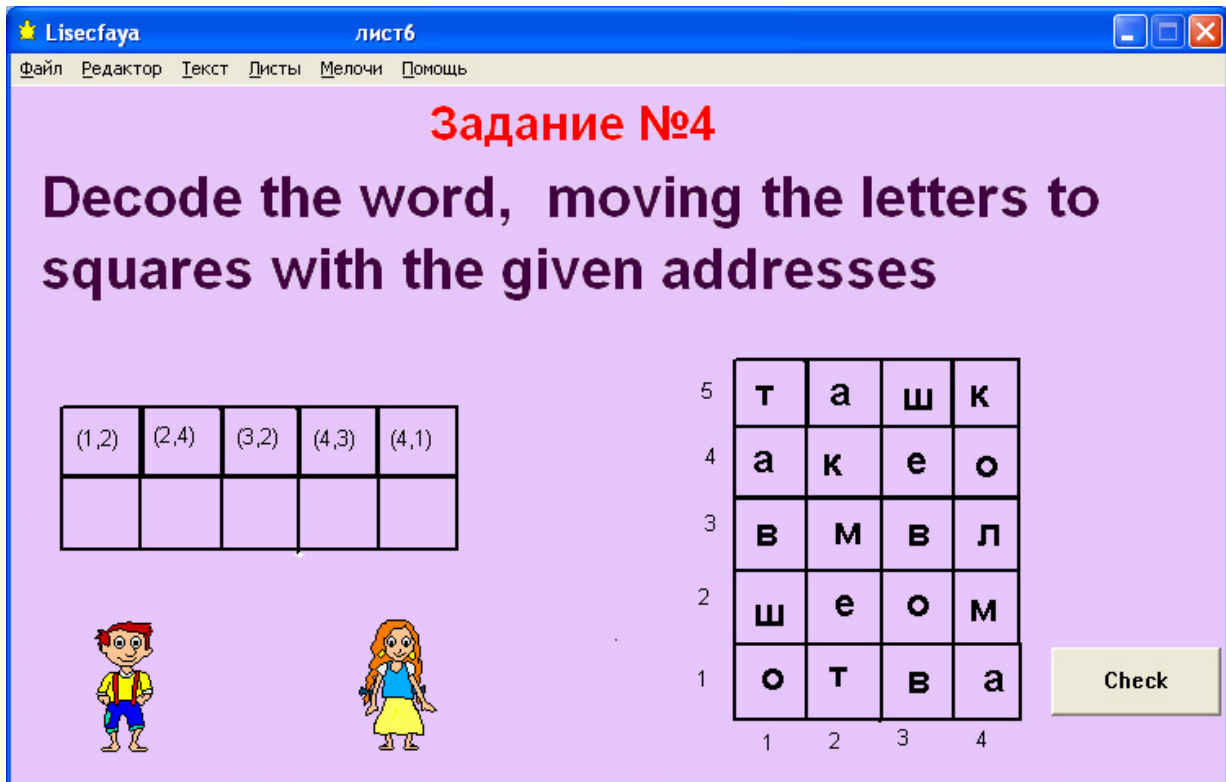


Figure 3. Assessment frame. The answer is put in by moving the letter-shaped Turtles. To start the programme the Check button is to be pushed. Assessment is carried out by comparing of the active Turtle's co-ordinate in axis x c , which is measured with the help of sensor $xcor$, with the pattern co-ordinates

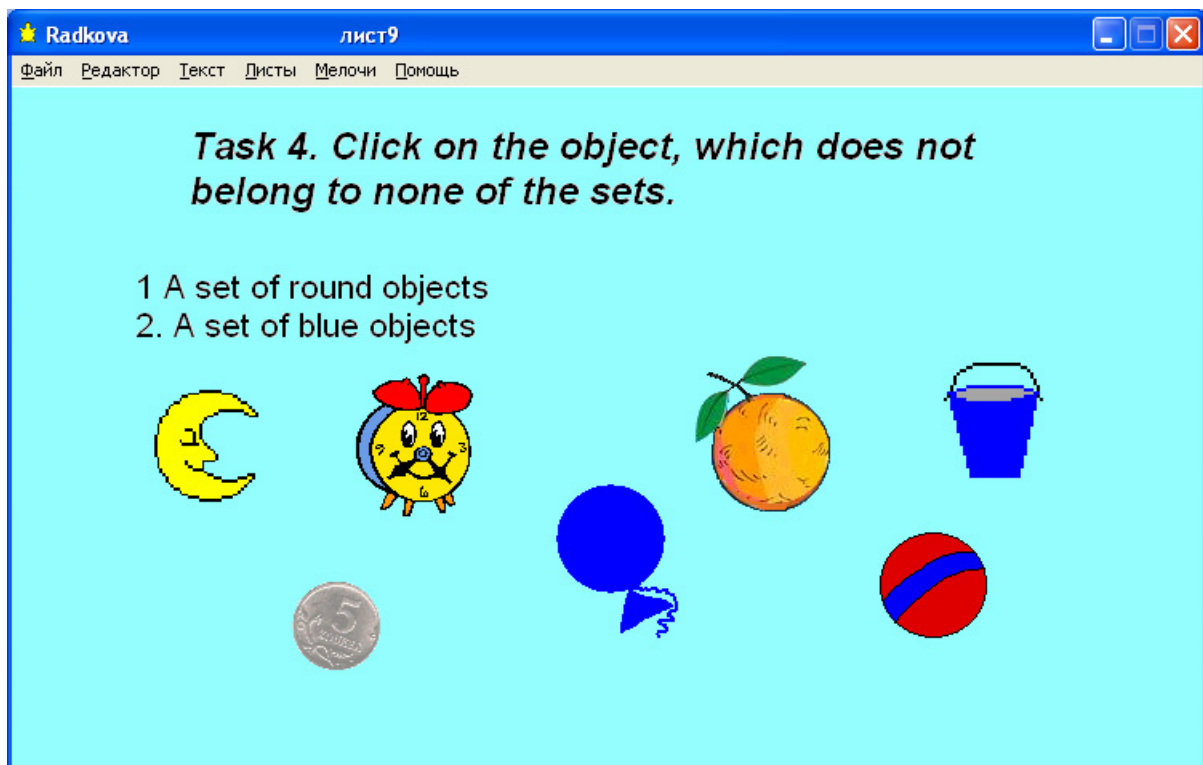


Figure 4. The answer is put in by clicking on the Turtle. Simultaneously the programme is started and the given answer is assessed

Ways of answer input

1. Clicking the programmed object (the Turtle, button, colour) lets starting the process at once and see the programme's reply on the screen. (Fig. 4).
2. "Manual" moving of the Turtle as a graphic object, word, symbol, number (see Fig.2, 3).
3. The Turtle manipulation (for example, changing its shape, colour)
4. Working with text:
 - text input (definite symbols, words, numbers) into the text or dialogue window (see Fig. 5).
 - text formatting (deleting, inserting, replacing part of a text)
 - symbols formatting (change of colour, size, outline)
5. Working with graphic images for example, deleting, filling in.

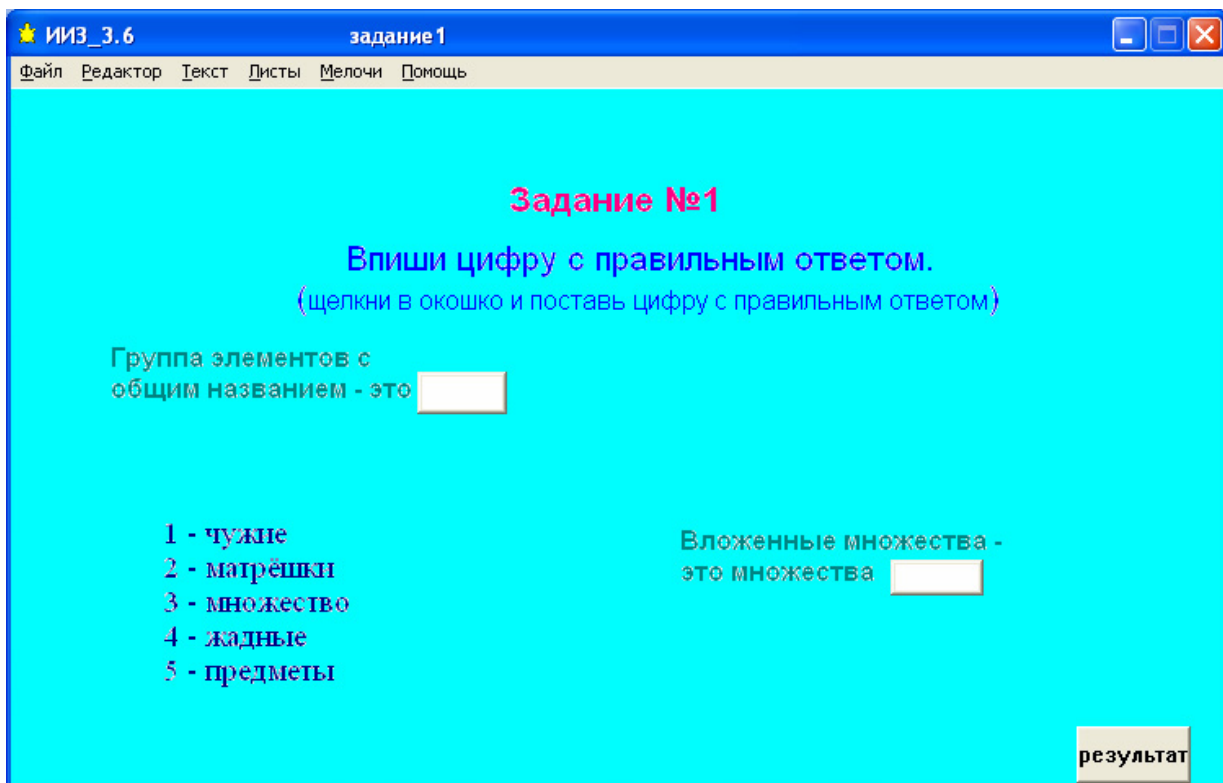


Figure 5. Assessment frame. The answer is put in the text window. After the answer has been put in the Result button is to be clicked

Let us thoroughly view the use of the turtle as the most "interactive" object.

1. In case the Turtle has been programmed the answer input may be realized by clicking on the Turtle (see Fig. 4).
2. The Turtle can be easily *moved* to the given area (see Fig. 2, 3), and its parametres may be measured with the use of specific sensors. Thus, for example, co-ordinates of the active Turtle may be measured with the use of specific sensors (*xcor*, *ycor*), and the colour of the marked its place position – with the sensor *colorunder*. The numbers (measurement results) may actually be viewed as children's answers which will be compared to pattern data of corresponding parameters.
3. The Turtle's most useful feature is a possibility to give it various forms – this is especially important for Elementary School. Thus, it is possible to attach to the Turtle not only shape of a picture, but also a number, a letter, a word. (see Fig. 3).

As shape an imported picture, created in the other programme (MS Word, Paint etc.) may be used.

The Logo language allows to realize the dialogue as a menu. For realization of menu in Microworlds the following objects may be used: buttons, programmed Turtles, and programmed colours.

The Right Answer Input Check-Up

Check up of the right answer is carried out by means of comparing answers with the pattern answers. Each answer is either clicking the specific object (chosen by a schoolchild) or co-ordinates of the Turtle having been moved by him or colour of the square, which a child had moved the Turtle on to, etc. For checking up the right answer programmed objects are often used. On a *Programme Page* necessary procedures are created, names of which are then written in instructions for these objects. The procedures include commands *if* and *ifelse*, which contain logical expressions with the sensors registering data on current parametres of the Turtle. The measurement results are compared to sample data (for example, colour number under the active turtle or its co-ordinates). In case a child's answer is put in by means of the Turtle's manipulation or text put in, for the programme start the use of a programmed object is required.

Reply on the Answer Input

Replying to the answer input the programme put a corresponding answer out. In education and training programmes in case the answer is wrong the mistake is analyzed, schoolchildren are recommended to revise the theory, solve a task again. (see Fig.6). In assessment programmes the credit number is displayed and then the next question is put out. Replies may contain both text and graphic objects, be accompanied with sounds. Replies output is carried out by various ways: into a signal window with the use of command "Inform" or into a text window (into a new one or cleared up from the old text one). All replies may be stored on a separate Page beforehand and be put out in when necessary.

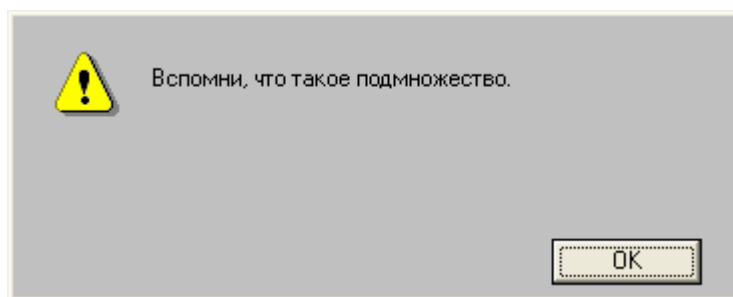


Figure 6. Reply on the given answer in a training programme. Is put out in the signal window

As mentioned above for a user, working with the programme it looks like a sequence of Frames following each other (images on the screen). One and the same Page with new information; the other one, stored beforehand or a signal window may be a Frame. The Frame change (change of the image on the screen) may be implemented by various means either by the user, or by the programme automatically. The programme opening from the required Page is carried out with the use of *startup* procedure.

Conclusions

At classes in the framework of the course «Information and communication technologies in Elementary education» students – would-be informatics teachers in 1st-6th years of Primary

Education Department work at development of individual projects. They realize the whole process of creating teaching and training programmes for Elementary School:

- analysis of a topic of Elementary School subject (Science, Mathematics, The Russian Language, Informatics)
- designing a programme
- a programme realization
- a programme expertise

As a result every student creates a scenario and a fragment of a teaching programme in each of the subjects of the Elementary school curriculum. Students analyze various resources of the Logo Language, assess them, and choose most appropriate ways of interaction realization, knowledge and skills control, use of the interface. ES for School has been elaborated as a project and is actually a programme in the Logo Language and a sequence of enumerated Frames linked to each other. Objects, graphic images, texts are created in the Frame, results of specific commands realization and complete programmes are displayed. The objects are programmed where necessary.

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