

# Teaching Computer Science Using Intellectual Interactive Learning Computer System

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## Abstract

*This paper presents a work in the sphere of individual computer based teaching. A computer system that teaches information engineering in the mode of intensive interactivity and corrects the educational process according to a talent of the taught person and one's requirements to the profundity of educational material, is described. The architecture of the system, which base are study and training blocks, is given. The architecture of a common study block, which consists of microsteps of teaching, is shown as well as the structure of a microstep of teaching and it's main stages. The flexibility of the Learning System allows it to be used in a wide range of intellectual and age level of taught people.*

## 1. Introduction

An active use of computer in all spheres of life of a modern human causes a heightened interest in study of computer science. The feature of learning computer science consists in the necessity to learn many new notions and standard mechanical actions based on relatively simple theoretical background. Moreover,

there are certain factors complicating the process of teaching: a wide range of age of people wishing to study (in our experience, from 8 to 65 years old), with ensuing age-specific traits of educational material mastering; various talents to apprehend new knowledge as well as intelligence levels; differential approach and requirements of taught persons to the profundity of material to be learned.

In such situation the optimal solution is an individual teaching [1]. However, it is the most expensive sort of teaching. An Intellectual Interactive Learning Computer System (IILCS) for teaching the base of computer science and Microsoft Windows [2], developed by us and being now under the test, allows to eliminate this contradiction.

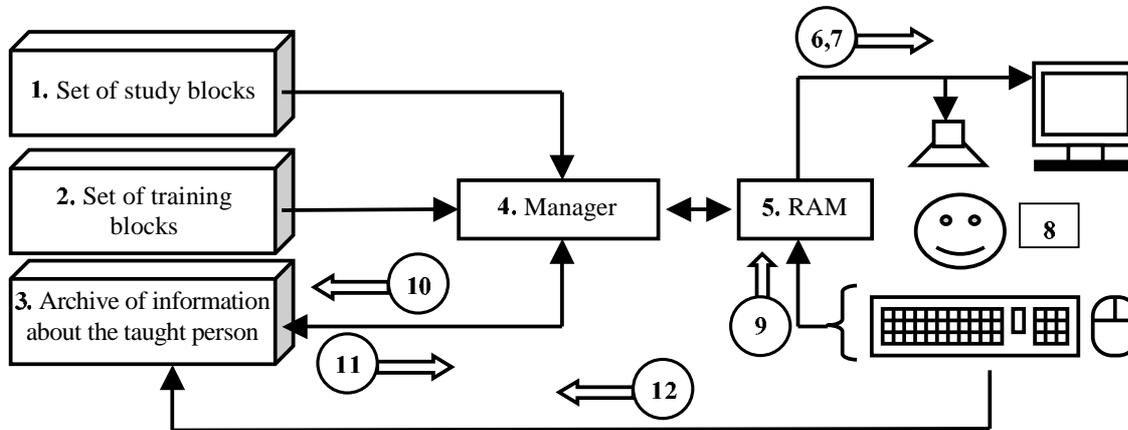
## 2. Structure of the IILCS

The architecture of the Learning System is shown in Fig.1. Sets of study 1 and training 2 blocks are its basis.

**A study block** is a logically and didactically accomplished unit of curriculum material. Its main function is an explanation of educational material **6** through natural presentation of information (i.e. through graphic images accompanied by the speaker's speech) in interactive

mode **9** [2,3]. A study block consists commonly of two unequal parts. In the first (largest) part a new curriculum material is presented, and the block is concluded with a small practical training **7** for fixing

new knowledge. At that the presence of the second (training) part does not abolish the intensive interactive mode during the explanation of a new material in the first part.



**Figure 1.** The architecture of the IILCS: **6** - educational material; **7** - task for practical training; **8** - taught person; **9** - feedback action of the taught; **10** - appreciation of intelligence level of the taught person; **11** - correction of educational process; **12** - task for study.

**A training block** differs from study one with the absence of new curriculum material and with detailed explanation of mistakes and erroneous actions to the learning person. It can include either one complex task or a plenty of not connected with each other minitasks. In the presence of mistakes during the training with this block the task repeats until it will be performed correctly. Training blocks serve to fix practically the knowledge, obtained in preceding study blocks [4], and are usually given at the beginning of the lesson (a common lesson is 90 min/day).

**Archive of information about the taught person 3** keeps initial information used for the correction of the teaching process. A consecution of study and training blocks presentation is determined according to the curriculum program **12** by the learning person **8**, who decides oneself on how profoundly one must know the course which is studied. The minuteness of material statement and training work, i.e. the correction of the

teaching **11**, is realized basing on evaluation of one's intelligence level and the level of material mastering according to the results of working with previous study blocks **10**.

**Manager 4** is a special program that organizes the work of the IILCS and selects the necessary study or training block, loads it in RAM **5** and starts it.

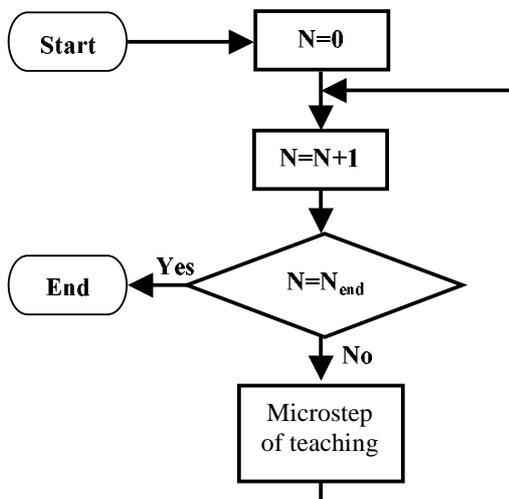
As it was mentioned, curriculum material and a task for training are presented to a taught person in the most comprehensible form - as graphic images with accompaniment by the speech. In our opinion such form of educational material presentation is optimal, because human organism is adopted to exactly such form of information incoming. Text information was brought to minimum since working with it requires additional efforts (sometimes considerable) for comprehension and mastering of educational material. That is why a text plays a subsidiary role in the IILCS, from time to time duplicating the most important

statements of the material being presented.

Feedback action **9**, that is the response reaction of the taught person (by means of a mouse or a keyboard) to the tasks, presented by IILCS, is used for correction of further educational process in this block as well as in subsequent blocks. And the stated curriculum material in blocks is built in such way, that a taught person is in continuous interaction with the computer.

### 3. A study block of the learning system

The basis of the IILCS are standard study blocks. Their architecture is shown in Fig.2. From the figure it is to see that a study block is the consecutive implementation of single microsteps of teaching.



**Figure 2. The architecture of a study block: N - the number of a microstep of teaching; N<sub>end</sub> - its final value.**

Here, as a microstep of teaching, is called a presentation of a minimal logically indivisible unit of educational material to the learning person as well as fixing it in one's memory. An ordinary block consists

of several tens of such microsteps. In Fig.3 an architecture of software realization of an ordinary block is given. Each microstep consists of five stages realized by corresponding program modules.

**The first stage (unit 1) – presentation of graphical information (pictures).** In most cases pictures are presented in dynamics, that is they are appearing and getting complicated little by little. This allows to understand logical relations in the curriculum material and to remember the picture better. The last is explained by a well-known biological phenomenon - in the first turn the attention is focused on a dynamical object [3].

**The second stage (unit 2) – speech accompaniment by the speaker to the graphical information, explaining logical connections and new statements that correspond to the picture on the screen.** The well thought-out, single meaning and logically correct building of phrases is here significant.

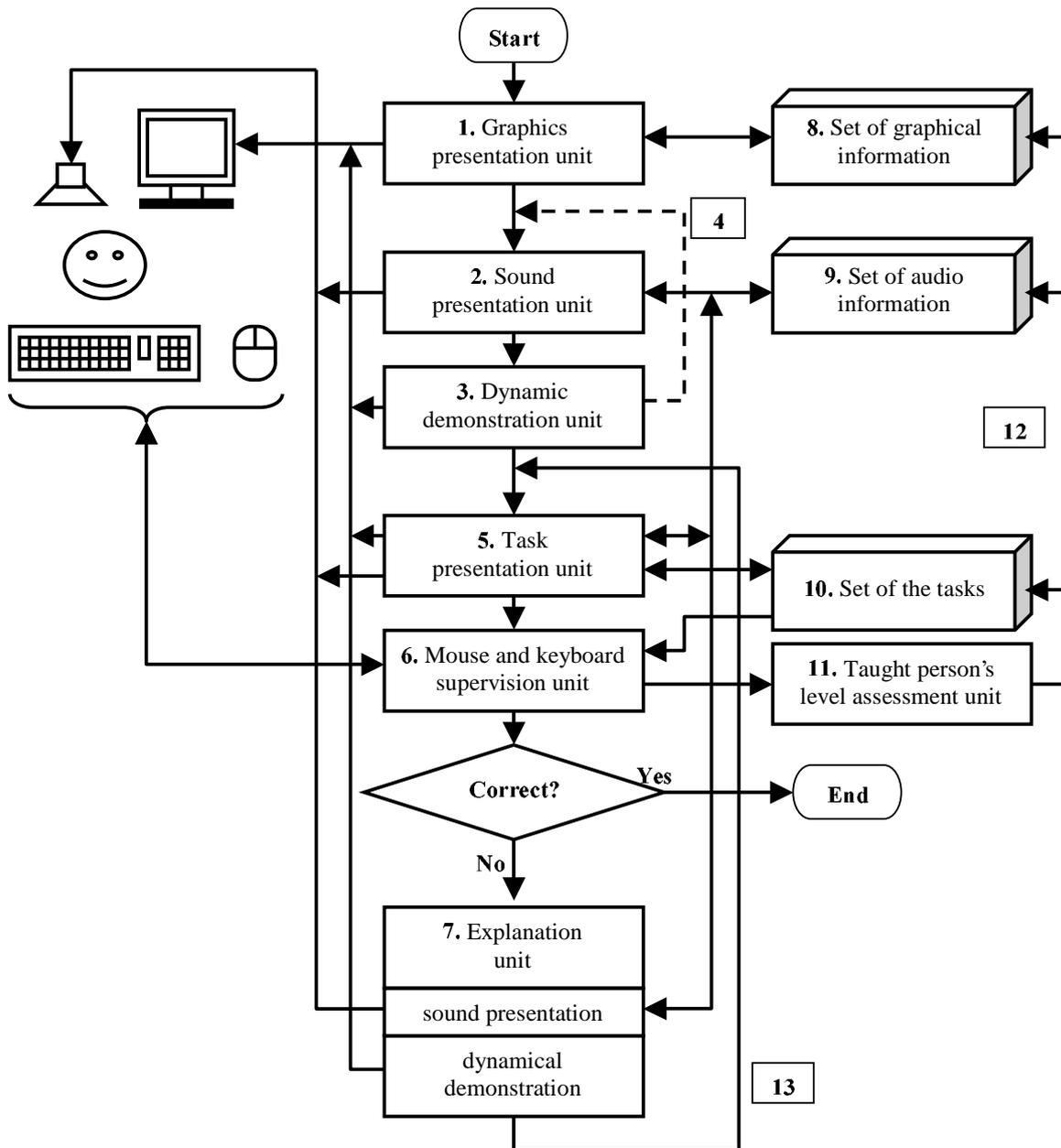
**The third stage (unit 3) – dynamical demonstration,** that is pointing certain parts of the picture with a moving arrow or with winking according to the speech accompaniment. This stage strengthens the effect of the previous one using the above mentioned biological phenomenon. In especially important cases, for the guaranteed attraction of an attention to the object on the screen, a special tone is used in addition to the dynamical demonstration.

Depending on the material being stated, the second and the third stages can repeat in various combinations (4). And the speech accompaniment (stage 2) is to be built so that the taught person is logically led towards the fourth stage.

**The fourth stage (units 5 and 6) – fixing of the educational material,** explained in this microstep, with an action. New knowledge is brought here to the sphere of practical application. This stage aims at three purposes: to keep attention

of the learning person at a high level; to check the accuracy of logical relations in educational material, that were created in the consciousness of the learning person

at the present microstep; to get such sorts of memory as motive, associative, visual, situation one to take part in the process of obtaining new knowledge.



**Figure 3. The Architecture of a microstep of teaching: 4 - repeating of sound and dynamic demonstration presentation units; 12 - correction of educational process; 13 - task repeating.**

The unit 5 forms and presents a task for practical training corresponding to the

current microstep of teaching. In the simplest case one is to point out the object in speech on the screen with the mouse

cursor. Formulation of a task always ends with a specific signal tone inducing to an action. The unit 6 controls the work of the taught person according to the task. By correct carrying-out of the task the current microstep ends and the next one begins (Fig.2). In event of erroneous actions the microstep is going on and the next stage runs.

**The fifth stage** (unit 7) – analysis and correction of erroneous actions of the taught person. In the simplest case one is told how to do it correct. Complicated situations propose a brief repetition of the curriculum material, but in slightly different form of statement. After explanations the task repeats 13. And it is going on like that, until the task is carried out correctly. The unit 11 assesses the level of the taught person basing on the results of practical work and corrects the further educational process within this block 12 (a degree of the minuteness of the curriculum material statement, the amount of tasks and a time for a task carrying-out vary).

#### 4. Strategy of learning by means of the IILCS

The teaching strategy is rather simple. A learning person makes oneself comfortable at the computer, puts on headphones, and the IILCS presents study or training blocks according to the curriculum plan of this person. Training blocks are presented in the beginning of a learning session in order to fix the previously studied material. The duration of a teaching session is defined by the taught person and can vary during the course. It is commonly either 60 or 90 minutes depending on self-appraisal of the own talent to a new knowledge mastering. The minimal course is 8 sessions of 90 minutes.

During the process of working with a study block the learning person tests and fixes new knowledge at once with practical training fulfilling the tasks given by

computer under its total control. One is in the continuous interaction with a computer and works at a pace prescribed by it. The duration of a study block varies from 5 to 20 minutes. After a study or training block is over, the taught person can decide between the variants of further actions:

- to take this block one more time;
- to go to the next study or training block;
- to finish the learning session;
- to put originated questions to the teacher and discuss the passed material.

In order to save a time and to devote more to a practical training with a computer, an in advance composed brief abstract of the study course is given to the taught person.

#### 5. Conclusion

The IILCS is being developed for two years. The level of it's completeness comes now to approximately 80%. Concurrently with the development of new study and training blocks, already developed blocks are being tested in the process of practical application. IILCS has been tested by teaching computer science 197 people of different age, intellectual level and professional skills.

During the test certain psychological phenomena, peculiar to computer based learning [2], have been uncovered. However, one of the primary advantages of the IILCS is a considerable reduction of the teacher's load. Chronometric measurements have shown, that in 64.5% of cases (127 persons) the time of the direct teacher's working with the taught person did not exceed 10% of the total working time of the pupil in the IILCS environment, in 32% of cases (63 persons) the time of teacher's work were from 10% to 20%, and only for 3.5% of cases (7 persons) it has exceeded 20% of working time under the direction of computer. A significant advantage of the IILCS is that a

studying person is hourly working, carrying out tasks and fixing obtained knowledge by its practical application.

Answers of the taught people to a question about their attitude to the computer based teaching using IILCS have been distributed in the following way:

- A very good method, this is even better than a common individual learning with a teacher - 27%;
- It's a good way of learning, I am absolutely satisfied with it - 48%;
- I prefer to study with a human teacher - 6%;
- I don't care how to study, with a human teacher or under the management of a computer - 19%.

Thus, the results of the tests are evidence of trends of the IILCS.

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