

## DISTANCE TEACHING OF PROGRAMMING AND POSSIBILITIES OF E-MAIL\*

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**Abstract.** A classification of teaching forms is introduced. One-to-many (group) distance teaching forms are discussed with respect to the means, which are used in the programming teaching process. The role and the possibilities of electronic mail in this process is discussed. The experience of Lithuanian Young Programmers' School by Correspondence is referred to.

**Key words:** teaching forms, one-to-many distance teaching, e-mail, teaching of programming, programming school by correspondence.

Nothing new under the sun?

Let's try to look at distance education from this point of view.

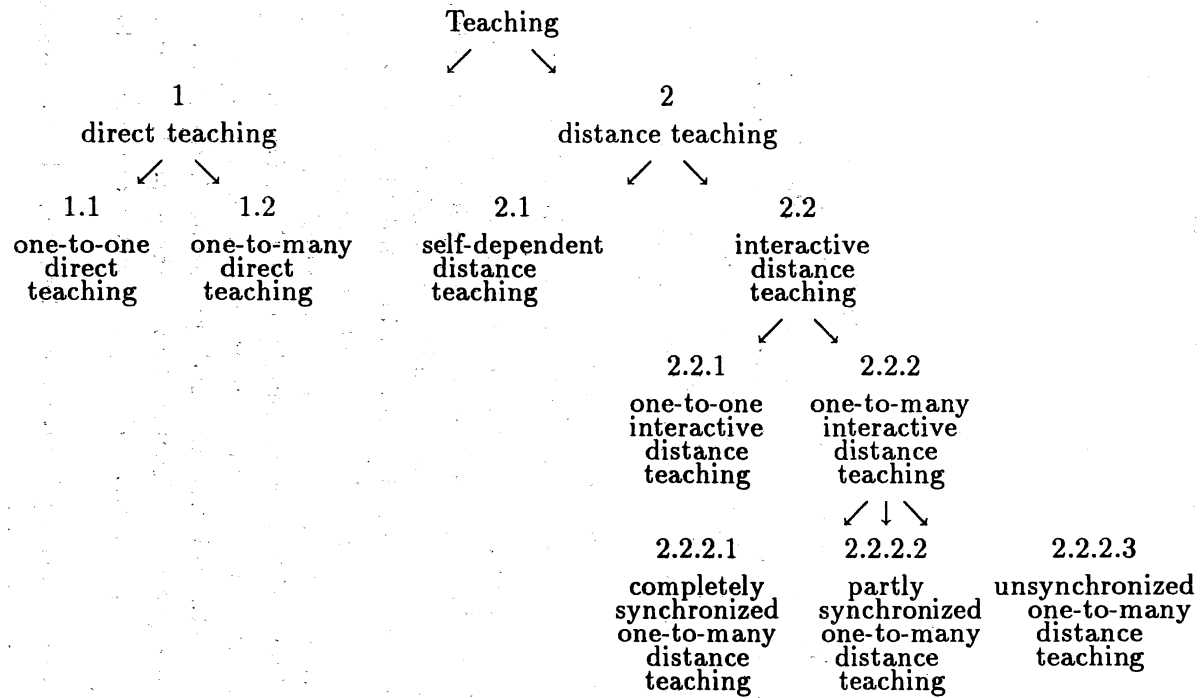
**An attempt to classify teaching forms.** Teaching can be divided (see Fig. 1) into two classes: <1> local (direct) teaching and <2> distance (by correspondence) teaching.

Direct teaching in its turn can be subdivided into <1.1> one-to-one (individual) and <1.2> one-to-many (collective or group) teaching. One-to-one teaching is the oldest education form: the teacher (master) teaches one pupil (apprentice). One-to-many teaching is a method when one teacher teaches many pupils. Direct teaching is always interactive and synchronized: the teacher says – the pupil repeats, the teacher shows – the pupil does, the teacher asks – the pupil answers, the teacher sets a problem – the pupil solves it.

Distance teaching (by correspondence) can be subdivided into

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**Fig. 1.** Classification of teaching forms.

<2.1> self-dependent (unary and unsynchronized) teaching, when a pupil is learning without a teacher (e.g., reading a book), and <2.2> the interactive one.

The interactive distance teaching can be subdivided just like the direct teaching into < 2.2.1 > one-to-one (individual) and <2.2.2> one-to-many (group) teaching. We should stress at once that one-to-many distance teaching creates an illusion of one-to-one teaching for pupils because the pupil contacts only with the teacher without any direct contacts with other pupils.

**One-to-many distance teaching.** One-to-many distance teaching can be further subdivided into <2.2.2.1> completely synchronized, < 2.2.2.2 > partly synchronized, and < 2.2.2.3 > unsynchronized teaching. Now we shall analyze these three groups with respect to the means which are used in the teaching process. In this context we can speak only about the means which ensure a feedback: periodicals, broadcast or telecast, a posted mail, and an electronic mail.

In the completely synchronized one-to-many distance teaching < 2.2.2.1 > case all four types of the means, mentioned above, are available. All of them were used in Lithuania [Dagys 1992]: programming lessons, published in the newspaper "Komjaunimo tiesa" in 1981–1985; competitions of algorithm writing, arranged in the telecast "Informatics and computing" in 1986–1988; the activities of the Lithuanian Young Programmers' School by correspondence (further – LYPS) using posted letters in 1981–1985; and programming practice training by e-mail in 1992. In the completely synchronized teaching case all pupils start and finish their studies at the same time (if they don't give up earlier).

A partly synchronized distance teaching < 2.2.2.2 > allows the pupil to start and to end the studies relatively at any time. It would be almost impossible to implement this form of teaching by means of broadcast or telecast, because this sort of program is addressed to a narrow and specific audience. The scheme of this kind of teaching using periodicals was designed a few years ago, but it was not implemented. The LYPS is functioning in such a manner

since 1986 up till now [Grigas 1987, 1990]. New participants can enter the school every month, and they study at an individual rate. However, the participants' solutions are distributed for a month so, that the examiner checks up a batch of control tasks of one level and goes over to another level batch.

Neither periodicals nor broadcast or telecast seem to suit the unsynchronized one-to-many distance teaching < 2.2.2.3 > (except for the section "Questions – Answers"). Only the mail is suitable, both traditional letters and files, transferred through the e-mail. Only the activity of the teacher's advise for a pupil and its automatization can be discussed in this context.

Before doing that, we shall try to compare the distance teaching forms, using traditional correspondence as well as e-mail means, with respect to given possibilities. We shall refer to the 12-year experience of the LYPS. While discussing this, one shouldn't forget that the advantage of the one-to-many distance teaching < 2.2.2 > is that it creates in pupil's mind an illusion of the one-to-one teaching.

**A comparison of the traditional and electronic mail possibilities.** Using the traditional mail as the main means of the one-to-many teaching by correspondence < 2.2.2 >, one faces such most noticeable weak points:

- 1) letters circulate rather slowly;
- 2) one needs a lot of time to prepare the letters (to write the addresses and glue the envelopes, to arrange printing and duplication of methodical matters, task texts and information sheets);
- 3) one needs a lot of time to evaluate the solutions, because each task (usually consisting of 4 solved programming problems) is evaluated by exploring the algorithms (without computer);
- 4) the programming learning and computer are too much dissociated.

Many of these problems can be solved by e-mail:

- 1) the information exchange rate between the school and pupils can extremely increase, so children can have more time to solve the problems;
- 2) the matter mailed to addressees can be prepared only in

computer file and no efforts are necessary to take care – either of printing or of duplication;

3) not only the algorithm quality (correctness) evaluation by using well-considered computer tests can be automatized, but also the attempts to automatize activities, such as program editing, some programming culture errors evaluation, and presentation of remarks on typical errors made in the problem solutions [Klupšaitė 1989], can be made; in this case there won't be any syntax errors, because the pupils would find them themselves while debugging their programs;

4) involving much more computer activities in the LYPS work should allow to gain some new advantages: children gain not only programming knowledge, but also obtain practical skills in computer operating, their motivation to learn in this particular school increases, learning becomes more interesting and attractive.

**The purposes of programming teaching and the characteristics of mail means.** There are some reasons, why learning by correspondence using e-mail can't absolutely substitute (and it's not likely to substitute in future) the teaching using traditional mail letters. These reasons are closely connected with a specific teaching purpose the LYPS has as well as with the characteristics of the LYPS teaching process.

It is impossible to start teaching by e-mail right now, because the tasks are not suitable for using this particular means of teaching: one can't solve some programming problems just by using the computer (but these problems are interesting from the algorithm-creating point of view); some problems are for reading and if the pupil solves them, using a computer, they will be of no use to him (they ought to be solved without the help of computer in order to perceive the essence of a concrete programming structure); other problems require to write only some fragments of an algorithm; some problems deal with the Lithuanian text processing (they can be solved well only theoretically, but in practice the algorithm will submerge in the details of the Lithuanian letter processing, e.g., sorting of text). The correctness of such programming problem so-

sorting of text). The correctness of such programming problem solutions can not be evaluated using computer. The present tasks should be changed in order that it were reasonable to carry out them, using a computer and to send them by e-mail.

Another reason, which does not allow to admire too much the usage of e-mail in the teaching process, is connected with the very purposes and primary principles of the LYPS. We have to stress that this school is not a mere school of programming teaching. This school helps also to develop pupils' systematic, algorithmic way of thinking and their programming culture. A computer can hardly substitute a human being in pursuing the mentioned purposes. The programming culture teaching is the activity, which can be formalized with great difficulty (is it possible to evaluate by computer tests such aspects as the meaningfulness or the meaninglessness of identifiers, visual presentation of algorithm text, sufficiency of comments in the text of the program?). Remarks on the programming style of a concrete pupil, advice for the improvement of his algorithm efficiency could be given only by a human being, not by the computer. That is why the most time consuming process, i.e. reading and examining of the program text, should remain in the case of transferring tasks using the e-mail too. One more time-consuming process will be added, i.e. printing of all program texts posted by e-mail. Why is it necessary to have hard copies of programs? First, the examiner has to see the entire program text (otherwise, it would be difficult to evaluate the whole), but a limited display screen does not allow it. Second, we want to keep the visualization of the examiner's remarks, which are considered to be most effective among all the means in the distance teaching. Different colours, letters and symbols of different size as well as various graphical information (arrows, diagrams, and others) serve for increasing the visualization of remarks, written on paper, for emphasizing the most significant passage in the examiner's remarks or advice, for pointing out the primary sources or errors, etc. While typing remarks in the pupil's program, using a computer, such a visualization won't be achieved or in order to

achieve it a powerful software has to be developed (usually text editing possibilities of the programming systems are poorer than those of word processors) and much more time and efforts have to be spent operating with a computer. Besides, the remarks written by hand are psychologically more acceptable for a reader, they allow to feel personal relationship with the examiner. Non-formal contacts between pupils and teachers are very important.

After evaluation of psychological and methodological differences of teaching technologies, some more considerations about financial expenditure are to be mentioned. E-mail usually is more expensive than the traditional mail (the lease of line costs is higher), as well as the cost of computer and software is higher than the cost of posted materials (envelopes, paper, and others).

### **Conclusions.**

1. It is possible, though not necessary, to apply the e-mail means for <2.2.2> one-to-many distance teaching at the Lithuanian Young Programmers' School by correspondence. We should not benefit greatly by such teaching under these conditions, which already exist.

2. However, there is a teaching field, where the e-mail could be used best for the one-to-many distance teaching (completely <2.2.2.1> and partly <2.2.2.2> synchronized teaching). This is the learning from the experience of other friends (colleagues), i.e., while analyzing their achievements, weak points and errors in the programs, developed by them.

This teaching method was successfully checked in 1992, when training Lithuanian pupils for the Third International Olympiad in Informatics, and in the LYPS Summer School. Such a principle of work organization was also used in one phase of programming practice session by e-mail, in November–December, 1992.

3. Speaking about the unsynchronized one-to-many distance education <2.2.2.3> we have mentioned the possibility to automatize this kind of teaching. It should be elaborated an educational course as well as the computer banks of test tasks arranged in order of their complexity. The tasks could be formed by teachers. So

teaching, would be increased. However, we may try to automatize the teacher's work. What comes next? Surely the computer-aided teaching system, which is operating without teacher's interference, i.e., a self-dependent one-to-one distance teaching <2.1>!

The circle spins round: aiming at increasing the feeling of one-to-one relationship in the one-to-many distance teaching case we come back to one-to-one teaching. But it can't be otherwise, when one is trying to automatize job, i.e., continually decrease the interference of the human being.

4. We dare say that a popular for many ages <1.1> one-to-one teaching (master-apprentice) form is most productive for a pupil, though it isn't most efficient for the teacher (only one pupil). This teaching method is irreplaceable for the time being. But it can be considerably enriched by automatized (computer-assisted) self-dependent one-to-one teaching <2.1>. The modern school should follow this direction.

We are sure, that the self-dependent (unary) teaching <2.1> as compared to other distance teaching forms, which have been discussed here, suits best for computer assistance. May be our fascination by computer application in other distance teaching cases is temporal? Computer is an excellent tool, but only a tool.

#### REFERENCES

- Dagys, V. (1992). Possibilities for voluntary development of school children. *Antroji mokyklinės informatikos konferencija*. Vilnius. pp. 8-13 (in Lithuanian).
- Grigas, G. (1987). Informatics and creative thinking. *Third International Conference "Children in the Information Age"*. Part 2. Sofia. pp. 229-240.
- Grigas, G. (1990). Some aspects of teaching the art of programming by correspondence. *Informatika*, 1(1), 156-166.
- Klupšaitė, A., and D. Stanžienė (1989). Errors and weak points of programs created by the students of the Lithuanian Young Programmers' School by Correspondence. *Informatika*, 14, 22-40 (in Lithuanian).

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