PROGRAMMED INSTRUCTION AND THE TEACHING OF GRAMMAR: A COGNITIVE VIEW

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Since the early 60's the general conception of programmed language instruction has changed considerably. In language instruction (as in other domains of instruction) we have become interested in programming short instructional sequences designed to teach a specific point of content rather than in programming whole courses, long textbooks, etc. This change was an effect of a general change of attitude towards programmed instruction (PI), which lost its status of an ultimate, scientific form of instruction and thus came to be regarded as one very efficient teaching technique, which should be integrated with other techniques, but should by no means replace them. Such a more realistic (and, in a sense, more restricted) conception of PI has increased its applicability in different fields of instruction, because PI no longer being one, rigourously defined and self-contained method becomes thus adaptable to particular learning tasks. In other words, in PI a given style of programming ceases to be the main factor determining the structure of the teaching content, but, on the contrary, becomes dependent on the structure of the course, losing most of its former rigidity with regard to such elements as the format of the teaching frames, modes of response, the way of providing the learner with the feedback, etc.

This change of attitude towards PI was largely due to a considerable body of practical experience with PI accumulated in the system of general education, in business and industry, in military training, and wherever else PI was used. On the theoretical grounds, however, it is a fact of the utmost importance that PI is no longer automatically associated with the behaviouristic approach to learning, and its assumption that the aim of a teaching programme is to shape the student's behaviour by a series of external stimuli. In cognitive psychology such an explanation of programme functioning is, of

course, inadmissible. As two eminent psychologists A. Leontiev and P. Galpierin (1970 : 314) say, in behaviouristically based programmes

> only a system of influences on the student, a system demanding definite answers is directly programmed, and not his activity directed towards securing this answer and, even less, the process of mastering this activity.

It goes without saying that the rejection of the behaviouristic conception of PI is not identical with rejecting PI as such. However, the cognitive conception of PI must be compatible with the general cognitive conception of learning, which considers any learning (even the learning of motor-skills) as a primarily mental activity (Talyzina 1971 : 11). An important feature of such a cognitive approach to learning, which is clearly opposed to behaviourism, is a conviction that the student's mental activity can (and should) be controlled and guided in the course of the instructional process. The behaviourists are not interested in such control, as they place all the mental activity of the student into a "black box", impenetrable for external observation. For a behaviourist the control upon the student during instruction must therefore be limited to control of the input to and the output from the "black box". On the contrary, the main function of a cognitively-based programme is to control and guide the cognitive process of the learner (and not his observable behaviour). As a conclusion it should be admitted that arriving at actual control of the students' cognitive development in the direction of a given learning task is the indispensable condition of optimisation of PI. Any teaching programme which does not fulfil this essential requirement can be said to function only in an indefinite and haphazard way.

In the teaching of functional grammar the instructional process must pass through several steps which are presented as phases of the grammar exercise (Marton 1974). The phases are qualitatively different and the whole process is extended over a period of time, its general direction being from the conscious knowledge of a functional rule to its active internalization, automatization and reduction. In view of what has been said about the preference for short programmes it becomes obvious that the possibility of programming the whole exercise must be excluded. Quite naturally, the particular phases of the exercise will differ in their susceptibility to programming, the more advanced ones being unquestionably less susceptible to it. It is even doubtful whether the total programming of the advanced phases of the exercise, with the exclusion of nonprogrammed instruction, is feasible (and advisable) at all, for, as Mueller and Harris (1966) say, "a number of concessions to the communicative aspect of language have to be made". On the other hand, this communicative aspect of language is not directly present in the first three phases of the exercise, which, as a whole, form the introductory stage of the new material. This fact alone might suffice to establish the stage of introduction as

the most suitable for programming. However, other positive reasons account strongly for this. First of all, it should be remembered that in the cognitive model of language instruction the importance of the way in which the new material is presented and introduced cannot possibly be overemphasized. Once we agree on the importance of functional rules in second language learning, we must attach great importance to the mode of presenting and introducing them. Not unexpectedly the phase of formal presentation was of a lesser importance in the audiolingual approach, were the drill was charged with at least a part of functions assigned to the presentation in cognitive teaching. Assigning a major role to the introductory stage finds its theoretical justification in the stage theory of learning (Galpierin 1965a) and one of its basic concepts, i.e., orienting (or orientational) basis of action (OB). According to this theory, the OB is an objective element which is constructed by the learner (or given to him) at the beginning of learning. Experiments have shown that the only elements of the learning task which are actually learned by the student are those included in the OB (in Talyzina 1971 : 72). The completeness of the OB is therefore a factor of the utmost importance for the process of learning and its results. Whenever the OB is not complete, the learning proceeds through a trial and error process and the results are accidental and unstable (Galpierin 1965b; also research reported in Talyzina 1971 : 34). Hence, the most important objective of a grammar programme will be to provide the student in a controlled way with an adequate OB for the mastery of a given structure.

Another important reason for selecting the stage of introduction as an object of PI is the practical consideration that a number of classroom teachers still lack adequate qualifications for the job. Programming the introductory part of the grammar exercise would on the one hand help them with the most difficult task and on the other make the rest of their work on grammar more effective.

Having thus defined the place of PI in the overall scheme of the teaching of grammar we should now aim at analysing what will be required from the student working with a teaching programme. This brings us into the area of task analysis, which undoubtedly has contributed most to the general effectiveness so far achieved by PI (Duncan 1972 : 19). Paradoxically, at present task analysis cannot be based on one universally accepted, objective and reliable system categorizing all the learning behaviours, as such a system does not exist. The attempts of such authors as Bloom, Gagné, or Leith to supply a system applicable to all learning behaviours have only been partially successful, as the systems worked out are fairly general, being hence difficult to apply in practice, and lacking the indispensable reliability. It seems that the main difficulty, still unsurmounted, in providing task analysis with a theoretical framework is that what is needed by practicians is a rather de-

tailed classification of behaviours readily applicable in programme-writing practice, whereas, on the other hand, a system containing all the varieties of behaviours must be general to be usable at all. The procedure most often adopted in practice for analysis of the learning task (especially in case of short programmes) consists therefore of empirical description of this task based on what might be called general logic and common sense. The philosophy underlying such an approach to task analysis (called operationism) is best summarised by R. B. Miller's statement "... that training should be based on what the operator or maintenance man has to do, rather than on the theory of operation of the machine or the physics of the phenomena" (in Duncan 1972 : 24). It seems that this empirical approach to task analysis (common in the industrial and military training) might very well be applied in language teaching, on condition, however, that the final description of the task is pedagogically oriented, i.e., contains not only a list of operations inherent in the task, but also the order in which they should be learned. If, speaking in general terms, the essence of PI lies in controlling the student's cognitive activity, then to describe a learning task means to establish a precise sequence of changes in the student's cognitive structure which the programme is to bring forth. Such a sequential description of the task may be quite rightly called an algorithm, as it manifests all the features which, for L. N. Landa (1967), are characteristic of algorithms — in the first place it makes certain arrival at the right solution (here: mastering a given structure), then, it is applicable to all the problems of a given class (here: all the instances of occurrence of a given structure), and finally, it determines the way in which the task is performed for all the learners (with the assumption that this is the optimal way). In other words, an educational algorithm shows how the learner's cognitive structure develops, or rather should develop, following a strictly controlled order of operation. Of course, for a set of programmed grammar exercises, the observation of the order of the underlying algorithm is an indispensable condition of the final success.

In the teaching of functional grammar (as in other fields) the normal procedure should be from the simple to the complex, and, thus, the first distinction to be made should be the one between the levels of reception and production, the former quite naturally preceding the latter. This distinction is a basic one, for, if considered as learning tasks, the two levels are obviously composed of qualitatively different operations. Distinguishing the two levels, neglected in audio-lingually based teaching, is advocated with regard to non-programmed instruction by various authors, e.g. Marton (1974), and Szubin (1974).

On the level of reception the first operation of the student must be to perceive and record all of the formal features of a given structure. As a learning task, it is not trivially easy (as it might apparently seem), for there is a natural tendency among students to subsume the new material under existing cognitive structures with the result that the new formal features are often treated as redundant and, hence, insignificant (see George 1972). Then the student is to perceive and learn all the implications of these formal features on the level of content. This must be done successively following the algorithmic procedure, e.g., the mastery of the structure MODAL+PERFECT INFINITIVE should pass (on the level of reception) through the following stages:

1) Identification of the formal features — *He ought to have helped her* versus *He ought to help her*, *He has helped her*, etc.
2) Identification of the past time reference — *He ought to have helped her* always refers to the past.
3) Identification of the implication of unreality — *He ought to have helped her* meaning *He did not help her* — with the exclusion of MAY HAVE and MUST HAVE.
4) Identification of the meaning of the modal and the full meaning of the whole sentence.

Each of the above steps should be present in the actual programme with the preservation of the algorithmic sequence. Introducing new grammatical structures in an improvised, uncontrolled way, with no attempt at gradual presentation of the new material (as is most often the case in practice) leads to a situation in which the students, receiving practically no help from the teacher, have to construct their own hypotheses as-to the functioning of the new structures and test them on their own. As a consequence, especially for more complex structures, the stereotypes formed in this way are very often incorrect or partly correct, even in the case of best students. Providing the students with an explicit rule for the functioning of a given structure does not help much, as the transfer between the knowledge of the formal rule and the functional rule tends to be limited.

As for the level of production, a very important element of the learning task consists in assuring the completeness of the formal features of a given structure. The student should also be given an opportunity to apply what he has already learnt about the content implications of a given structure to make contextually conditioned decisions. It should be remembered, however, that the objective of the whole programme is to provide the student with the OB, which he will subsequently use in the course of non-programmed phases of the grammar exercise.

Problems which have so far been treated in this paper are concerned with the general objectives of the programmed teaching of grammar and the order in which the content of the programmed course should be presented to the student. In what follows the problem of how to present the teaching content will be dealt with. The order in which these problems are discussed is by no means accidental, as it reflects their interrelations and the order of importance. It

would be quite impossible to discuss the technicalities of programme writing before the problems mentioned above have been resolved. On the other hand, the moment the main features of the prospective programme are known, at least a part of these technicalities become self-evident. A general principle which would apply here is that the "style" of programming (if it exists at all) should always depend on more general things, such as: the objective of the course, nature of the learning task, structure of the content, etc. Extensive research carried out in the initial period of the PI movement, which largely consisted of the comparison of the effectiveness of different styles of programming, brought results which were either inconclusive or contradictory. It seems now quite natural that cognitively based programmes, designed to function as the introductory part of the grammar exercise will have their own types of teaching frames, totally different from the ones used in behaviour shaping programmes. The technique commonly used in the latter case, known as "vanishing" or "fading of prompts" will be of no use here. Filling in "-lder", when the word is cued with "o-" is not a meaningful step[1]. The frames used in the type of programmes discussed in this paper will look more like a series of conventional exercises, as they will induce the student to make contextually conditioned decisions on the basis of the knowledge gained progressively from the work with the programme. In the first stage, when the student is to perceive the formal features of the given structure, the frame must contain a contrasting pair of sentences for which the feature(s) in question is (are) the only element differentiating the two. (This, in fact, is an application of the concept of a minimal pair to the teaching of grammar.) A frame from a programme on comparatives might thus look as follows:

Which of the following pairs of sentences contain a comparison?
1) Mark is strong. His brother is stronger.
2) Moscow is a large town in Russia. London is a large town in England.
3) Alice is a very tall girl. Her brother is still taller.

Quite obviously, the structure(s), contrasting with the new one must be known by the student.

In the next stage the student must learn the content implication of the given structure. Thus, the following type of exercise might be suitable for the teaching frame:

How old is each of the boys?
One of the brothers is six, the other is ten. Mark is older than
Peter.
Peter is..... .
Mark is..... .

[1] This example of a teaching frame is taken from a programme by A. Howatt (1969 : 5).

The frames for the level of production will also be made of exercises used in non-programmed teaching. Full use should be made of techniques consisting of the recognition of incorrect forms, construction of the correct ones, translation, paraphrase, etc. An advantage of such an approach to the programmed teaching of grammar is that it utilizes the existing repertoire of teaching techniques whose efficacy has already been verified. A number of problems which certainly will emerge in the course of using this type of programmes should be resolved in the only way in which, as it is generally agreed, the real value of any programme can be assessed, i.e., through empirical validation.

The principle of empirical verification, which according to K. Kruszewski (1974: 141) is the only didactical principle specific exclusively for PI, owes its importance to the fact that in PI it is possible to repeat an instructional sequence a number of times, and, thus, there is always room left for slight changes and improvement. Such practical problems as: the size of frame, the number of items in one frame, the degree of control over the student which the programme has to exercise (correctness of constructed responses), the proportion of overt and covert responding, etc. can be resolved by research carried out in "normal" teaching conditions. As J. Hartley (1972) put it, the function of such research is to "determine what factors make a method effective, and how these methods can be improved". The results of such practically oriented experimentation will thus be decisive for various aspects of the programmes discussed in this paper, but, for obvious reasons, will be of little value for designing other types of programmes, and of still less value for answering more general questions about PI. Such experiments are now growing rapidly in number since in the present situation the real problem about PI is not whether to use it or not, but how to use it.

The above statement might well serve to conclude the present discussion. To conclude it in a more specific way, the following points will be raised again:

1) In cognitively based teaching of grammar, the phase of presentation is the one most suitable for programming.
2) Programmed sequences should follow an algorithmic order of presentation with a precise distinction of the levels of recognition and production.
3) The optimal format of the grammar programmes will be established through practical experiments carried out in normal classroom conditions.

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