the theory and practice of programmed instruction

by jerry pocztar

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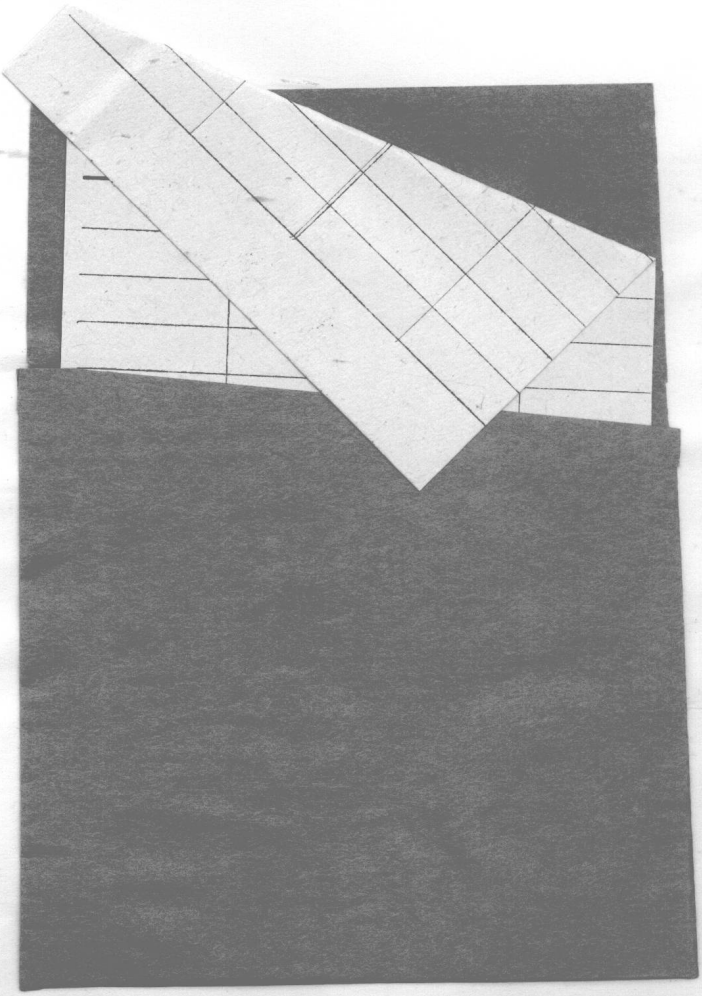

THE THEORY AND PRACTICE OF PROGRAMMED INSTRUCTION

A guide for teachers

by Jerry POCZTAR

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PREFACE

For a number of years, Unesco has endeavoured to assist Member States in perfecting teaching techniques and materials on a broader scientific basis, making particular use of the contributions of the psychology of learning.

The continuing nature of this endeavour is demonstrated by the series of Unesco-organized regional meetings and training seminars devoted to new methods and techniques. Most recently two experimental regional projects were launched to develop the applications of programmed instruction in the reform of school curricula. One of these projects is being carried out in four French-speaking Central African countries, following a meeting of experts in Brazzaville (July 1969), and the other in Asia, following a preparatory meeting in Tokyo (February 1970). Prior to the initiation of these projects, a meeting of experts, which took place at Varna (Bulgaria) from 19 to 29 August 1968, pointed to the need for an assessment of the theory and practice of programmed instruction in the form of a book directed specifically to teachers and teacher educators.

To prepare this book Unesco called upon Jerry Pocztar, Agrégé de l'Université, *who is in charge of programmed instruction at the Educational Research and Training Centre, École Normale Supérieure de Saint-Cloud (France) and who directed the 1969 Brazzaville training seminar referred to above.*

The book is intended as a guide for teachers who wish to acquaint themselves with programmed instruction; but it is also designed for those administrators or teacher-educators who will be involved in the development and promotion of this method of teaching. Of these readers, not all will need the same information. Administrators, for example, can acquire a good idea of what is involved in a trial scheme of programmed instruction in a school, and can help to ensure its success, without knowing particular psychological concepts. For the benefit of readers who wish to pursue this initial acquaintance further, references have been listed at the end of each chapter indicating supplementary reading. A short general bibliography at the end of the book lists major works which can help teachers to pass on an understanding of programmed instruction to their colleagues.

It is argued in the ensuing chapters that it is only through the practice of programmed instruction that the theoretical study of the subject can assume its real meaning. It is hoped that this guide may enable teacher-educators to lead teachers to the practice of programmed instruction, as a first step towards a scientific renewal of teaching methods.

It should be added that, consistent with the principles it expounds, this book will not be fulfilling its purpose unless it provokes feedback. From this first contact between teachers and Unesco's fund of experience should come a stream of exchanges which could be reflected in the Organization's future programme.

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INTRODUCTION

The year 1954 saw the field of educational methods and techniques enriched by the advent of programmed instruction. From the moment it was introduced by the American psychologist B. F. Skinner, programmed instruction achieved great success and made rapid progress: large sums were made available to experiment with it and put it into practice; the industrial and commercial press publicized the advances and setbacks of this new method of teaching; and research workers and educationists alike sought its aid in order to improve the quality of teaching. Programmed instruction ushered in the era of the industrialization of teaching and educational research.

With the advent of programmed instruction, books, machines and computers take their place alongside teachers at the conference table while teaching henceforth falls into the advertising domain and is bought and sold like any other product.

The healthy state of programmed instruction would seem to justify defining it in terms of an advertising slogan, and it is not hard to imagine a publicity campaign replacing the formal training of teachers.

The question: 'But what is this programmed instruction which you keep talking about?' would be answered by a poster or newspaper advertisement as follows: 'The modern solution to your teaching problems!' If a serious definition is required, we are as baffled as the philosopher who is asked to define philosophy. Like him we are tempted to reply: 'Come and take a look at what I do.' Such a reply may mean one of two things: either that programmed instruction is something practical and has to be experienced to be understood, or that it is merely whatever anyone wants to make of it. There is no shortage of definitions in the latter vein, from the broadest to the narrowest. For Professor Gagné, of Berkeley University, programmed instruction consists in making teaching models which take into account the initial and terminal response

of the student, are graded in accordance with a detailed schedule and permit intermediate assessment of the strategies employed. This definition is somewhat lacking in clarity for a layman unless placed in its doctrinal context. The same observation could, of course, be made about other definitions. Hence, rather than supply some new definition which would satisfy nobody, we propose 'to take a look' and thereby give everyone the information he needs in order to construct for himself a satisfactory definition.

Skinner himself put forward his invention as a solution to the problems of the shortage of teachers and the increase in the number of students which were a source of concern to all countries. Although this hope has not been fulfilled, fifteen years later the rapid growth of programmed instruction and the general interest it has evoked are sufficient proof that it possesses merits other than those which make or mar a fashion. More will be said later about these qualities of programmed instruction which explain its ever-increasing success, qualities which Skinner regarded as of secondary importance or did not even suspect. In any event it is certain that the foci of interest have altered and diversified. However, the problems of teaching are still with us and as regards both quantity and quality are becoming ever more acute. It is of course teachers who feel these problems most acutely.

There are many who are over-enthusiastic about these techniques which promised an increase in efficiency. Others, on the contrary, have reacted warily, fearing the teacher would be supplanted by machines which would '*depersonalize*' education. In fact, 'it may realistically be supposed that the development and use of computerized data processing will be beneficial to teaching. There is a danger, however, of seeing the climate created by the use of computerized data processing and its extension, programmed instruction, invading and dominating education to such an extent that there might grow up, in addition to the desired adjustments and changes, a wholesale, uniform and to some extent unpredictable mentality—that of the mechanized approach.

'Perhaps the sway of reason itself can only be saved if we retain in teaching relationships a certain degree of irrationality, to match the rich variety of human personality' [1].[1]

There are yet others, whose ideas should not be underestimated, who in the name of what they call 'realism' have expressed considerable reservations: what means will be employed to train teachers in these techniques and to plan their large-scale use?

1. There is a list of references at the end of each chapter; the number in brackets refers to the work quoted.

An exponent of programmed instruction almost invariably finds teachers giving vent to restrained or open scepticism, wholesale pessimism or unqualified enthusiasm. By dint of constant repetition these reactions eventually lose their impact and the exponent is often tempted to pass judgement on the ability of his audience to accept innovations. Reactions from all sides show significantly that the introduction of new methods implies a change in habits which goes against the grain of old and entrenched attitudes. There is an increasing desire to bring about these changes in attitudes. Programmed instruction also calls for such changes and if suitably presented can help to bring them about. The changes which it implies for teachers do not mean a radical break with the principles which guided them in the practice of their profession. On the contrary, it opens up new prospects, wider opportunities for putting those principles into effect.

The reality of programmed instruction is quite different from what is imagined and in no way justifies any of these extreme attitudes even though there may be grounds for legitimate fear or satisfaction, and even though many problems it claimed to solve are as yet unsolved. Somewhere between apologetics and indictment, and even though there is a good deal to be said on either side, there is room for more objective appreciation. But it should be emphasized that this objectivity is not readily acquired, nor is any easy way to it offered here. To arrive at it one must make a critical and informed analysis of the theories and techniques of programmed instruction, comparing them with other teaching techniques and with the general principles of teaching which centuries of experience have revealed.

This wealth of precautions and preliminaries may be found somewhat frightening. There is no cause for alarm. The practical side of programmed instruction can be mastered in less than a month. And a broad view of the theoretical references can be gained by reading through two or three books and a few journal articles. In other words, nothing in the training which programmed instruction requires resembles an initiation to the mysteries of some new rite. Neither in theory nor in practice is it the preserve of specialists. On the contrary, the teacher ought to be proficient in both, for he alone can put them to the test. Those who are at first impressed by the seeming complexity of programmed instruction are often deluded by the specialized language or jargon which cloaks the simplicity of its principles and ideas. It could all very well be included in the teacher-training course but this often seems a gamble, since the very title 'programmed instruction' is already somewhat off-putting. The second word

is easily understood, but what, on the other hand, is hidden behind the first, redolent as it is of so much that is unfamiliar. It is important to avoid being impressed by the words; 'programmed' is merely a qualifying adjective and its significance lies in how it changes the nature of 'instruction'. These changes are real. If they are only on the theoretical level then they will be of little importance to teachers, who will not see their effect. If they are apparent in the class-room, then teachers and pupils will be the first to judge their impact, though they will have to use them properly. But before we can envisage this happy state of affairs, some general reactions which may prevent its ever occurring must be overcome.

THE USES OF TEACHING MACHINES

Teaching machines are credited with greater uses and capabilities than they really have. Both enthusiasts and critics are responsible for this. The former claim that they can teach, since what is taught can be analysed and therefore be disseminated by a machine. The latter assert that *how* something is taught is as important as *what* is taught and that automation is deadening. Who is right? No one is in a position to judge: it is impossible to analyse completely what is to be taught, and it is therefore difficult to find machines which can automate the transmission of what is to be taught; consequently, if there is no actual automation, there can be no deadening effect. There are, however, machines which can help us to confront the ever-increasing numbers of students. How can they be used to improve the quality of teaching also? We still do not know. But this does not mean we shall never know, nor that nothing can be done until we do. Numerous experiments have already been carried out, and even if we are still short of the goal in respect of both quantity and quality, at least the problems can be more clearly seen in all their complexity. In the search for realistic answers which satisfy both the demanding teacher and the national authorities, programmed instruction will make a significant contribution. The polemics of enthusiasts and detractors alike are thus pointless on the level on which they argue. They ought therefore to be invited to attend to the problems arising from the present experiments: they will discover fairly quickly that their opinions are not as far removed from each other as they thought. A look at the experiments which have been conducted will reveal that the subjects or concepts which can be analysed ('programmed') and taught by machines are not necessarily those originally imagined.

Similarly, when a particular subject is taught by a machine, it is found that the teacher, far from being excluded from the

teaching process, becomes an even more vital part of it. There is as yet no evidence whatever to suggest that the conflicting claims of quantity and quality will pose a threat to the teacher or make him redundant. On the contrary. . . .

It is true that machines can take over certain tasks of the teacher such as the transmission of knowledge, the immediate correction of mistakes, drill, etc. But can it assume them all? This question raises in some minds another fear which is expressed more or less as follows: teaching machines—books, display devices or computers—ought to enable the child to learn on his own. The efficiency with which they do so will be in inverse proportion to the number of functions they assume. Thus they will only be able to reproduce a very diluted form of the teacher-pupil dialogue. The more unsophisticated the machine, the less it will be able to take the place of the teacher giving a lesson to his class.

A vital distinction must be made here. It is sheer common sense: the 'machine' is merely an 'aid' to the lesson. The pupil learns his lesson through use of the aid. The more complex the aid, the more complicated will be its use. For convenience sake we will therefore call the device in question an 'aid' and the lesson which it can present a 'programme'. This distinction reveals a characteristic of programmed instruction which could form part of its definition: it can be said to involve techniques which enable a 'programme' to be constructed and then entrusted to a certain kind of 'aid' which will fulfil the role of 'teaching machine'.

CONTENT OF THE PROGRAMME

The content of the programme and the way in which it is arranged may be affected by the nature of the device or aid. This consideration will assist us in examining more closely the objection already mentioned, which amounts to emphasizing that recourse to an aid, however elaborate it may be, impoverishes the teaching process by dissociating its elements and thus sacrificing its unity. It is true that there is dissociation of the different elements of teaching. However, to conclude that this dissociation results in impoverished teaching is to prejudge the way in which the aid and its programmes will be used. Why is this a hasty conclusion? Here again it is possible to give a direct and detailed answer but there is no guarantee that the information supplied by way of answer will be given the careful consideration required for reader acceptance. The teacher-educator will frequently note the constant preoccupation with preserving the advantages of teaching as a unity. This concern is not to be despised, but when it relies on arguments

such as those above, it illustrates a form of unwillingness on the part of teachers to face up to the demands which the use of new techniques makes on them. Before the advent of the spinning-jenny, the weaver with his coiled thread produced cloth by a series of intricate movements which he performed very well. To increase production these movements had to be analysed and distinguished and in this way it was possible to allocate each of them to a different element of the machine. The breakdown of the movements and the separate elements of the machines brought about higher productivity. Why should the same not be true when there is a need for the 'mass production' of better-educated students? The spinning-jenny did not affect the quality of cloth but the quantity produced was enormously increased [2]. It is possible to imagine that the mechanization of teaching might produce similar results.

It is instructive for the teacher-educator to express the objections in these terms, because these questions raise others which are closer to those facing research workers today. It is easy to see how far weaving is removed from teaching. The components of cloth are well known and an observer can clearly distinguish the movements of the weaver. Are we, however, as familiar with the pupil as we are with the threads of a piece of cloth? Are we certain that in giving a lesson the teacher weaves one by one the individual threads of knowledge? These are the two goals programmed instruction has set itself in order to stand up to comparison with traditional methods. On the one hand it asserts that it is possible to define the potential of the student in relation to what he must learn. On the other, it claims to supply the methods and means of providing this tuition with a 'productivity' comparable to that obtained in industry. A metaphor will indicate how far short of these goals contemporary research still is: 'upstream', behind us as it were, programmed instruction undertakes to define a student's nature and potential in relation to what he must learn; 'downstream', still ahead of us, it indicates the actual tools to impart this knowledge. In between flows the river, representing the teacher at one with his pupils, his subject and himself! As we shall see, in its course it often meanders, not infrequently disappears altogether and when it re-emerges one is not always sure whether it is the same river or not.

Some will claim that we are taking excessive precautions to anticipate teachers' objections, but experience has confirmed that great weight must be attached to them. Many failures in programmed instruction derive from prejudices which have not been completely eradicated rather than from difficulties inherent in its techniques. Teacher-educators, school administrators and teachers

must be aware of them since they must answer these objections and promote new attitudes both in teachers and in students. Indeed, one of the criticisms is the danger of setting teachers and school administrators at loggerheads.

Programmed instruction is merely one of a number of teaching aids, but its use will revolutionize school lessons since students will work by themselves at their own pace. Moreover, if there is to be a continual assessment of attainment and if progress from one class to another is based on these results, this will mean the end of the time-table which is carefully planned in the autumn and then followed to the end of the summer. All this is implied, as is shown by even the most elementary application of programmed instruction. There is no reason to suppose that this will result in complete chaos. On the contrary, it would appear that the more effort that is made to adapt to the individual student, the greater must be the diversification of methods and means; but it also seems necessary that teachers and administrators should plan the work in a more co-ordinated and structured fashion.

Teacher-educators cannot but endorse these objections. The teachers who voice them are anxious to know how to use programmed instruction and they easily foresee the difficulties they will have within the school or college in which they work. They are aware, and rightly so, that willingness, necessary as it is, is not everything. The problem which then arises is one of means, and this is even the very crux of the matter. Indeed, what benefit will teachers gain from a training which they will not have the opportunity to put into practice? This question can be answered in two parts: (a) we are convinced of the value of programmed instruction in teacher training, even if the teachers are not destined to use programmed lessons themselves; the costs, on this level, are low in relation to the benefits; (b) once one is dealing with actual use in schools, the objections do indeed assume their full weight. They will be considered again when we come to define the conditions under which programmed instruction can be used to give pupils the advantages (economy, efficiency, adaptability, etc.) it holds out.

We shall endeavour, on the basis of a concrete example [3], to define these conditions, bearing in mind that they must take into account local circumstances. It will, however, be for the local teacher-educators and administrators, once they have seen the different possibilities offered them by programmed instruction, to make a choice among them.

THE HISTORY OF PROGRAMMED INSTRUCTION

For the benefit of teacher-educators, frequent reference will be made to the objections, reservations or misunderstandings which they may expect to meet when themselves describing programmed instruction. One way to forestall these objections is to recall the historical background. Although this background may have very little to do with the theories and techniques of programmed instruction, it helps us to understand their development and their success. The present introduction will provide a broad outline; Chapter I will be devoted to the basic psychological principles which led to the invention of programmed instruction by Skinner; Chapter II indicates the lines along which these principles have developed into different types of programmed lessons; and Chapter III describes programming techniques and the part played by team work. Lastly, Chapter IV suggests certain guidelines for launching a programmed instruction project, pointing out some of the major problems which can be expected to arise.

First, some historical facts. Programmed instruction is too recent an invention to reveal anything more than wavering trends or tendencies in its evolution. Curiosity in regard to the theory and the resulting new terminology has frequently concealed the real reasons for its seemingly spectacular development. The general public regards it as a revolutionary gadget, but one which is still only on the drawing-board. The gadget in question is not totally new: it concerns teaching. The only problem is to know how far teaching is 'programmed'.

While some trace it back ultimately to Descartes, others to Galen or Socrates, programmed instruction is generally recognized as being the invention of the American psychologist, B. F. Skinner. The terms 'instruction', 'teaching' and 'education' have all been used, and there are nuances depending on which of the three it is desired to 'programme'. The reader will have to interpret the term according to his individual choice in the matter.

As for the old-established, everyday word 'programme', this has latterly taken on meanings which have made it both more specific and more popular. We are all familiar with the everyday usage, which relates to concerts, theatres, radio or television. The programme provides a descriptive notice of an event which is to take place. The significance is not the same for the organizer or the producer as it is for the viewer or the listener. In fact, for the organizer, a 'programme' specifies the detailed schedule of a number of co-ordinated actions and the allocation of roles and responsibilities with a particular end in view.