TECHNOLOGICAL CHANGES AFFECTING TEACHING METHODS IN PHYSICAL EDUCATION

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«Science and Technology *seem destined to be* among the primary determinants of the events of the second half of the twentieth century.» (Walter Buckingham).

Education appears to be on the fringes of a series of revolutionary changes in methodology. These changes involve the application of recent advances in technology to teaching. It would appear that methods of education which have remained relatively unchanged, will be changed in a startling way. These changes may reverberate throughout the entire educational structure causing changes in the training of teachers, in the organisation of the curriculum, lesson planning, methods of teaching, school buildings, the selection of children for various types of education, etc.

To a certain extent, the recent application of technology to teaching has been linked with the increasing emphasis placed upon the individual child. This emphasis may be seen clearly illustrated in physical education. One has only to glance at a series of photographs showing typical physical education lessons, taken sixty years ago, thirty years ago and ten years ago, to see the focus upon the individual child becoming progressively sharper. It would appear that one trend emerging in recent years has been to concentrate upon the realisation of individual potential. In order to perform effectively, the teacher has been exhorted to observe carefully the responses of the individual and, on the basis of these responses, give further instructions, etc.

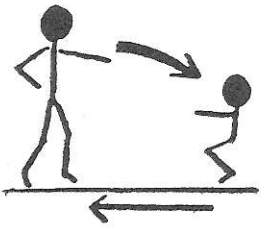

Fig. 1

Teacher and pupil in continuous constructive communication.

Feed back from pupil to teacher affecting next instruction.

With large numbers of children (30) at widely different ability levels and developmental ages there is an increasing tendency for this ideal of individual tuition to break down. Roughly speaking, the technologist and the experimental psychologist have provided a method that enables this ideal individual teacher-pupil relationship to be maintained, even in the face of a large number of children.

The method attempts to maximise direct feed back control: «The teacher modifies the student and the student modifies the teacher by feeding back information about his difficulties which should cause the teacher to revise his subject matter presentation» (1).

The teaching machine is the device which enables the process indicated in the above quotation to be put into action.

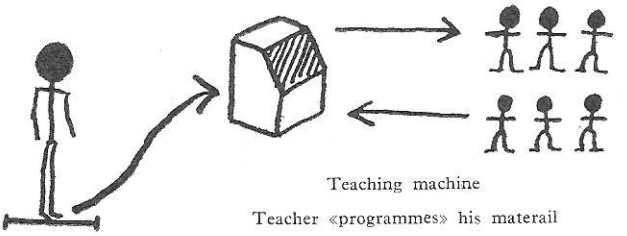

Fig. 2

Much of the development work on teaching machines was inaugurated by B. F. Skinner fifteen years ago. In a paper entitled «The Science of Learning and the Art of Teaching (2), Skinner outlined his view that the principles of learning discovered in the psychological laboratories could be applied to everyday teaching, but only if the extra work entailed by this application was handled by a machine.

The following useful summary of the main principles outlined by Skinner is taken from an article on *Teaching Machines* by J. Annett, H. Kay and M. Sime: «Skinner's work centres round the effect of reward; the most important way in which it differs from Thorndike's work is in an improved experimental technique. Reward or reinforcement cannot help until the right response has in fact occurred. Skinner's technique ensures that the right response will occur, as an example will show: Skinner places an experimental animal in a simple box that usually has a lever which the animal can press to get a reward of food. There is little else, indeed, the animal can do, except preen itself or go to sleep, and so the simple response is soon learned. If we want to teach a more complex response, it must be built up or «shaped» by teaching first a number of simple component responses. For example, a pigeon can be taught to walk a figure-of-eight by first being given a reward when it makes any turning movement. Later when turning is well established, the reward is made contingent on changing direction and very soon a full figure-of-eight is established.»

These factors of simplification, reward and gradual shaping of complex responses, are the essentials of his experimental technique and of the teaching machines he has devised. Skinner is convinced (as many other psychologists are not) that telling a student his answer is right, is a sufficient reward and is, in a sense, comparable to the animal receiving food on making the right response. In a human the reward value of being right is derived from long experience. It is secondary, rather than primary reinforcement, but Skinner contends, essentially the same in its effects. Even in a highly congenial classroom rewards are less frequent than in the laboratory. In a classroom, particularly a large

one, the teacher has no time to check the details of an individual's performance. Skinner's answer to these problems follows from his experimental technique; the use of a machine becomes necessary for reasons of economy. By analogy the subject matter to be learned has to be broken down into small steps which will be components of the ultimately desired complex responses. These steps look like very simple questions and often are statements which call for the insertion of missing words. When a student answers the question correctly he has, by analogy, made a response which is part of the total behaviour to be learned, and he is then rewarded by the information that he is correct. Normally a teacher would think it odd to ask only questions which he expected to be answered correctly, but to approximate this situation is, according to Skinner, of the greatest importance.»

It has been possible to incorporate the approach suggested by Skinner into the compilation of a simple effective teaching machine in the shape of a programme of small steps in book form. «A programmed textbook differs from an ordinary textbook by presenting the subject matter in small logical steps, giving an item of information and asking a question which the student should (and usually does) answer correctly; by turning the page the answer is confirmed. In this way a complex concept is built up step by step» (1).

Although Skinner's work may be useful in programming certain skills for pupils with a specific background of experience (3. 4. 5. 6. 7. 8.) a major part of this article is devoted to a discussion concerning the application of principles of branching or non linear programming. This type of *programming,* developed largely by Crowder (9.), is more applicable to pupils with a varied experience in motor skills. Non linear programming depends upon the responses made by the learner. If the learner makes the correct response he is directed to the next stage but if he is unable to make this response or he makes one of a number of incorrect responses, he may either repeat part of the problem or undergo a special remedial sequence appropriate to this kind of failure (10.).

The Physical Educationist asks two questions concerning the use of teaching machines. Are they necessary in physical education? Is it possible to teach motor skills via a teaching machine?

In answer to the first question it must be emphasized that there are many by--products resulting from the process of learning motor skills, apart from the acquisition of a certain level of performance, that the Educator considers important (11.). It is suggested that there are certain areas involved in teaching motor skills which would benefit from the application of a teaching machine approach. It should be possible to teach basic essentials of certain skills, for example, the headstand or parts of a cricket stroke. Where there is a shorttage of specialized teachers then programmed instruction should enable the specialist to make full use of his material.

A further value of teaching motor skills via programmed instruction is that we should be able to investigate more thoroughly the way in which a learner builds up a relatively complex skill. Many of our progressional stages used in teaching skills, such as trampolining or diving to beginners, have been formulated in an apriori manner and refined empirically. It has been difficult, due to the variables involved to investigate the effectiveness of these teaching methods. It would be possible via the use of programmed instruction, to have one group of learners responding to one set of stimuli and compare their progress to a group of learners following a different programme (10.).

In answer to the second question, Annett, Kay and Sime state; «Motor skills, which quite often already involve the use of expensive apparatus and stimulation, could be machine taught; in fact, the teaching machine could be an integral part of the equipment».

It would appear that the use of teaching machines would be rather more complicated than suggested above, but not insurmountable.

What appears to be required are:

a) A means of giving instructions to the performer.

b) Programmed material which will break down complex movements into very simple elements that will lead to a progressive build up of the complex skill.

c) Some means of informing the performer of his action and how far it is approximating to the correct movement.

d) Some methods of basing further instructions upon the performance of the individual.

In a random sample of thirty boys aged 11 + there is usually a small number who are able to perform an effective handspring immediately following a clear demonstration. This ability is largely determined by their past experience. It would be an inefficient process to lead these boys through a series of progressive stages. It would, therefore, be necessary to work out empirically a number of test stages involved in a handspring movement. Where the past experience of the boy was insufficient to enable him to perform one of these stages then he would be referred to a series of graded activities culminating in the final handspring. Our present knowledge of the development of many skills is insufficient to work out this type of programme but this is not to say that it is not possible. Indeed a quick look at some of the programmed material will show that a great deal of extra, but perhaps more fruitful labour, is required of the teacher.

It should prove possible to programme motor skills such as handsprings or headstands in such a way that the child following the instructions will quickly acquire the new behaviour pattern. Let us take the case of a boy who has no past experience or ability in performing headsprings. He turns a button on the teaching machine upon which he is given instructions through a photograph or series of photographs to:

a) Place his hands, shoulder width apart, fingers spread out, on the mat. A partner checks that if his performance fits that shown by the instructions. If it does he turns the button.

b) Place hands as in (a) and also the forehead to make a triangle as shown in the illustrations. If this is performed successfully he obtains instructions.

c) Perform. (a) and (b) and lift the knees for a count of five seconds. This movement places more weight upon the new base of support. If this is sucessful the next instructions are followed.

d) Perform (a), (b) and (c) and then «walk» in with feet until the performer can lift the toes from the ground and hold the position for three seconds.



Fig. 3

If at any stage the performer fails to complete a certain activity, then he will be given instructions to turn to various practices contained within the programmed material that will assist him at this particular level of skill.

It is obvious that this type of teaching will throw responsibility upon the boy and his partner who is acting as a feedback indicating whether the performance is acceptable. This, however, is the same problem as that contained in the programmed textbooks.

The cost of elaborate teaching machines would preclude their being used to any marked extent by teachers of physical education, but simple, cheap and effective devices may be improved and used to assist the teachers wishing to experiment with this method of suplementing their teaching.

The programmed material for teaching headstanding could be made to fit in a simple box or tin. In this way the material prepared by a research team, could be made available to any number of individuals.

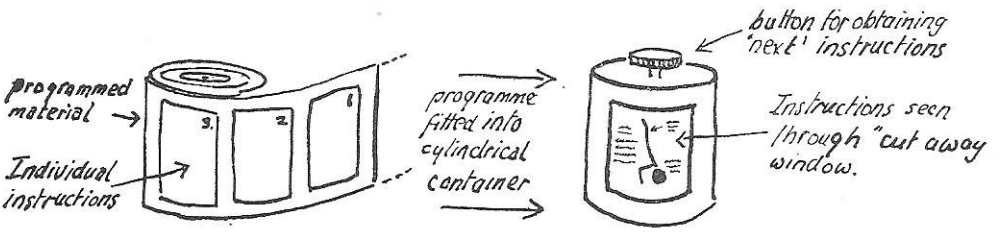

Fig. 4

In recent years more and more use has been made of the type of approach outlined above. In teaching skills, teachers have been advised to make use of models, flicker photographs, action photographs or charts, such as the coaching charts produced by M. C. C. or the Football Association ([12]). These charts have been used in such a way that groups of children of similar ability have consulted the charts, noted the main coaching points and attempted to carry out the instructions.

In much the same way older students, grouped in pairs, have studied a 16 m.m. film loop illustrating the main techniques of say breathing in free style swimming and then attempted to coach each other.

Many teachers have made use of prepared blackboards on which are written instructions at different levels. In a lesson where the children are set problems involving handstanding movements, the children are first required to support their body weight on their hands in various ways. The

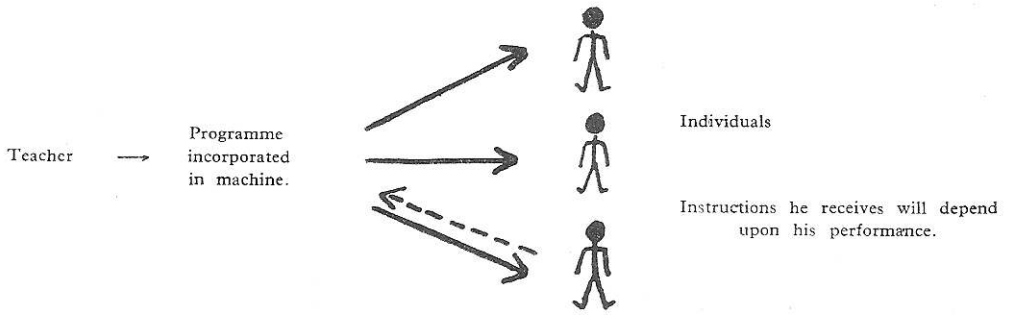

Fig. 5

problem is then made more specific and requires the child to produce a handstand. The children then attempt to balance on their hands for a period of time. Children who are unable to balance at all are required to move to one blackboard on which is written a number of movement problems involving the taking of weight on hands and which develop the ability of the pupil to produce a handstand. Children who are able to balance for five seconds, move to another blackboard which sets problems requiring balancing movements on various pieces of equipment and perhaps move to a specific problem involving a «cut through» type of movement.

Although research in the learning of certain motor skills through the medium of teaching machines and similar-devices is in an embryonic stage, it would appear that they may be used to supplement the variety of methods utilized by the physical educationist.

It is sometimes suggested that single teachers working alone with relatively large classes, are often unable to apply the following principles of learning:

a) Whatever a student learns, he must learn for himself, no one can learn it for him.
b) Each student learns at his own rate, and for any age group the variation in rates of learning is considerable.
c) Students learn more when each step is immediately reinforced.
d) Full, rather than partial mastery of each step, makes total learning more meaningful.
e) When given the responsability for his own learning, the student is more highly motivated, learns and retains more ([13.]).

Any teaching method that will assist the teachers of physical education to apply these principles when teaching psychomotor skills, should be given careful consideration. It is suggested that the approach outlined above is one on these methods.

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