

as that to acetylcholine; Jamieson (1962) found the intact trachea less sensitive to 5-hydroxytryptamine than to acetylcholine.

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March 29, 1965

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An experiment in programmed learning

SIR,—The principle of programmed instruction, by which a student is given an item of information and his understanding of it is then checked by means of a question before passing on to the next item, is not new and was in fact the method employed by Socrates. However, in recent years interest in this form of teaching, with or without the use of machines, has increased but mainly at secondary school level. The Report of the Committee on University Teaching Methods (Hale, 1964) reviews the state of programmed learning in the universities to date and concludes that the method should be applicable at university level but that its usefulness 'will require to be tested by trial and error'. It would appear that at the present time very little use is made of programmed material for undergraduate teaching in this country, the main impetus coming from the U.S.A. Even there, usage is still at an early stage in medical and similar courses (Allender, 1964) and although a few excellent programmes have been published in book form (Wolf & Crowder, 1964; Nice, O'Connell & Sykes, 1964), these are expensive and still leave very few programmes of instruction available that are directly applicable to pharmaceutical subjects (Gerraughty, 1964). The aim was to produce and use a short programme and compare this method of teaching with the traditional undergraduate lecture.

A programme was produced consisting of 60 "frames" covering 38 quarto-sized pages concerned with the mechanisms of urine formation. The method of programming was that attributed to Crowder—fairly large units of information with questions at the end of each frame which allowed for the correction of wrong responses. The material was presented in scrambled form in such a manner that answers to the question at the end of any particular frame were not in immediate juxtaposition. The experiment was made with first year undergraduate pharmacy students. The programme was given instead of lectures to 44 of the 88 students chosen alphabetically and they were asked to complete it alone, but with free reference to textbooks. The remaining group of 44 students was given two normal 1 hr lectures, care being taken to cover during the course of the lecture every item of information included in the programme. After one week had elapsed both groups were given a 30 point objective test of a fairly searching nature designed to check both factual knowledge and understanding. An analysis of the results of a previous and more extensive examination had shown that the mean marks of the two groups were statistically indistinguishable. In addition those students who had read the programme were

asked questions designed to determine their attitude to this type of learning. The results are shown in Table 1.

TABLE 1. A COMPARISON BETWEEN A GROUP OF STUDENTS STUDYING A PROGRAMMED TEXT AND A SIMILAR GROUP RECEIVING LECTURES

	Programme group	Lecture group
Students tested after programme	42	40
Students tested after lectures		40
Mark from previous objective test (79 possible); mean \pm s.e.	46.7 \pm 1.1	46.5 \pm 1.1
Mark from objective test on urine formation (30 possible); mean \pm s.e.	*12.7 \pm 0.6	11.1 \pm 0.6
Hours spent on studying programme or in lectures; mean \pm s.e.	2.4 \pm 0.2	2.0
Additional hours declared spent in private study; mean \pm s.e.	0.5 \pm 0.1	1.2 \pm 0.2

* Significantly different ($P = 0.99$).

Whilst obviously no far reaching conclusions can be drawn from a single trial such as this, it is evident that the students who read the programme were at no disadvantage compared to the lectured group and that the total time spent on the topic by the two groups was about the same. In fact the slight improvement shown by the programme-group is statistically significant compared with the control group receiving lectures. Of rather more interest was the attitude of the students to the programme method. 66% said they would like more programmes but often qualified this by saying that they should be in addition to and not instead of lectures. However, only 39% preferred the method to lectures and 32% said they enjoyed it less than lectures. Obviously the effort of writing a programme vastly exceeds that of preparing the equivalent lectures—Hale (1964) states 100 hours of preparation result in 1 hr of student study time—and if these results are typical the rewards would not seem to be comparatively large. The most common complaint from the students was that at the end of their period of study they were left without a set of lecture notes in a suitable form for subsequent revision.

However, in view of current criticisms of the lecture (Robbins, 1963; Hale, 1964) as the main method of conveying information and the current students demand for more individualistic modes of instruction, it is felt that more experiments with programmes covering a range of undergraduate subjects would be well worthwhile.

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April 14, 1965

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