Whether scientists are the ones to decide about scientists might be debated. On the whole, perhaps this form of gossip should be discouraged, if only because discovery of the truth might injure their status as recipients of hero worship.

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Programmed Instruction and the Arts

With reference to the editorial "But you have premises to keep" [*Science* **136**, 837 (1962)], while the objections to the technique of programming evident in *Poetry 230* are well taken, it does not necessarily follow that the type of subject matter treated in this text is inherently unsuited for programming.

The editorial did not make clear to me whether its author considered poetry in general, or Frost's short poem in particular, unsuitable. However, the main question appears to me to be: What does one want from an analysis of a work of art (literary, musical, or other)? It seems to me that no analysis —whether by text, college professor, or teaching "machine"—can make a student like, or even appreciate, art. What can be done—and perhaps the only thing that can be done—is to instill in him an understanding of the ideas of the artist and of the materials and techniques which the artist uses in his attempt to communicate these ideas. Clearly, if a sensitive student can understand and appreciate Frost on first reading, then for him it makes no difference how a supplementary analysis is presented, for he will be able to see these techniques in the light of feelings which the poem has already evoked in him.

For the student who cannot appreciate a particular work of art, it is necessary to prepare a background and an analysis. While all that may be necessary to comprehend a Frost poem is careful rereading, there is a wealth of fairly subtle constructive techniques employed in each one. To direct the student's attention to these, and to get him into the habit of looking for such techniques, may be just the stimulus needed to evoke genuine interest and appreciation.

We are, therefore, led to ask: Can a well-programmed text help the student to acquire the sensitivity and background necessary for the development of appreciation? To this I think the answer is yes. In fact, I should think the programming techniques come as close as possible to a serious classroom discussion headed by an inspired professor. Unlike a textbook, a good program demands that the student be continuously thinking and applying what he has learned to new situations. I have noticed that many students whom I have tested on various programs show a marked increase in reading sensitivity. The good programs capture a certain acuteness and sense of discovery which are extremely important factors in learning to appreciate poetry, music, and literature.

Programmed learning is a relatively new technique, one that, unfortunately, has been used by many who have failed to master it. In particular, its application to the arts has been, so far, rather clumsy. Eventually some sensitive artist, musician, or poet with a gift for writing will come along and show us how it *should* be done. Just as programming in the hands of some mathematicians has taken much of the boredom from math and replaced it with insight and excitement, so may programming yet serve the other branches of the arts and sciences.

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The most inexperienced programmers realize the danger of analyzing a single frame (item) out of sequence and context. Yet the writer of the editorial "But you have premises to keep" attempts to do exactly this, selecting the following frame for his excursion into literary criticism: "Even Frost would probably not have forced so much rhyme on himself if he had planned a long poem. Since he doubtless had a hunch that this was to be a _____ rather than a long poem, he decided to increase the difficulties of his rhyme game still more."

The primary objection given is that "the basis for a hint is supposed to be something more than the redundancy of a sentence made redundant for no other purpose."

The only redundant portion of this frame is the phrase "rather than a long." The purpose of this phrase, as any programmer will recognize, is to provide a thematic prompt (by introducing contrast) for the correct response, "short." A rereading of the article

"Teaching machines" [*Science* **128**, 969 (1958)] will show that redundance didn't seem to bother B. F. Skinner. Indeed, his sample frames on the spelling of the word *manufacture*, are most redundant, by the standards of the editorial.

Incidentally, concern over redundance is not reflected in one of the sentences of the editorial: "the basis for a hint is supposed to be something more than the redundancy of a sentence made redundant for no other purpose."

The fourth paragraph sets forth this interesting non sequitur: "A little programmed learning is a dangerous thing. But better understanding would not mean doing a better job; it would mean not attempting the job in the first place."

Isn't the criterion for the presentation of learning material via programmed instruction to be found in the teacher's ability to specify what verbal behavior the student is to have in his repertoire after completing the course? If this "desired terminal behavior" can be explicitly verbalized, the material can be effectively programmed, often as an enriching adjunct to the total classroom scene.

The last sentence of the editorial poses some interesting questions. It reads, "There should be warning enough in the contrast between the pretentiousness of this exercise and Frost's poem itself, 16 short lines of simple narrative." Do we take this to mean that analysis of any "simple narrative" is wrong, since the length of the analysis must exceed that of the narrative? (In his 1958 article in *Science* Skinner outlines a method of studying poetry at the high school or college level, spending "20 or 24 frames on four lines of poetry.") Such thinking smacks of the unscientific and anti-intellectual views of the 19th-century Romantics—that to analyze a work of art is to strip it of its beauty and meaning.

To be sure, there are gifted students who have learned to read such "simple narratives" critically and in depth without help from teachers or others. But for most students, this form of verbal behavior, like most others, is arrived at by imitation—that is, with the help of one whose repertoire of experience is worth sharing and whose ability to point out latent, symbolic, and secondary meanings will enhance enjoyment of the learning process in general and of the reading of poetry in particular.

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