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A Comparison of the Abilities of Secondary Teachers and Students to Understand Science (a follow-up study)

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A comparison of the level of understanding of science between secondary teachers and students was made by P. E. Miller in 1962. The measuring instrument used was the Test On Understanding Science (TOUS), Cooley & Klopfer 1961. The science teachers were compared with groups of secondary students in grades seven through twelve. The results are shown in Table 1.

It was discovered that 38 per cent of the high-ability eleventh and twelfth grade students scored above 50 per cent of the teachers in the study. The results indicated that a sizable group of teachers had less understanding of science than their students. A call was made for increased professional standards and improved college curricula designed to train teachers better in the ways of science and the scientist.

Since 1962, science education in secondary schools and colleges has felt the impact of summer and academic year institutes, new curriculum devel-

opments, in-service institutes, and programs for high-ability high school students. Science teacher training programs at the college level have been modified to prepare teachers to teach science both as a process and as a body of knowledge (Van Deventer, 1964). This has been an attempt to implement more thoroughly the philosophy characterizing the new curriculum programs such as PSSC, BSCS, CBA, ESCP, and others.

The question is, what has been the effect of this effort, aimed at doing just the thing Miller called for in 1962? Have teachers been trained to better understand the ways of science and the scientist in order that they may transmit this understanding to secondary students?

The original design of Miller's study has been maintained; the TOUS test has been administered to seventh, ninth, and high-ability eleventh and twelfth grade students. The test was also given to in-service science teachers. The results are shown in Table 2.

Table 1 (Miller, 1962)

Group	Mean	Per cent above 25% of Teachers	Per cent above 50% of Teachers
Grade 7	23.6	1%	0
Grade 9	31.1	19%	3%
11 & 12 High-Ability	42.1	68%	38%
Biology Teachers	43.6	—	—

Table 2 (Schmidt 1966-67)

<i>Group</i>	<i>Mean</i>	<i>Per cent above 25% of Teachers</i>	<i>Per cent above 50% of Teachers</i>
Grade 7	24.9*	0	0
Grade 9	34.0*	14%	5%
11 & 12 High-Ability	41.0*	47%	9%
In-service Teachers	45.5*	—	—

*Each mean is significantly different at the .01 level, from the next lowest mean.

The 1966-67 data indicate that the problem still exists as Miller pointed out four years ago; a sizable group of secondary science teachers understand science no better than students they may be assigned to teach.

What is the value of instruments such as TOUS? Do they really measure understanding of science as scientists themselves perceive the scientific enterprise? To attempt an answer to this question, working scientists in Iowa universities and industry were asked to take the TOUS test. One hundred and sixteen scientists were willing to give their time to respond to this request. The mean score on these tests was 50.8. This mean was significantly different from the mean of the in-service science teachers. In addition, the test was administered to a small group of college seniors (N-29) enrolled in courses in science methods; the mean was 48.0. A group of prospective elementary teachers at the sophomore level enrolled in an elementary science survey course (N-43) scored a mean of 40.5 on TOUS.

Summary and Conclusions

1. The problem still exists as Miller pointed out four years ago; a sizable group of secondary science teachers understand science no better than students they may be assigned to teach.
2. Significant gains in the under-

standing of science as measured by TOUS are made as students progress through the science education sequence in Iowa schools.

3. A small group of methods students, freshly tutored on the nature of science and the philosophy of modern curricular programs, exhibit a good understanding of science as measured by TOUS.
4. Working scientists score best on the TOUS. However, their mean score is ten points less than the maximum possible score. This indicates that a respectable score on TOUS is somewhat less than previously expected. It also indicates that several TOUS items need to be revised or replaced.

This study seems to indicate that we must seek ways of improving the understanding of the scientific enterprise for the in-service teacher. Perhaps this can be done by providing experience in science with scientists instead of more courses about science. What kind of activities can be provided for the high school student to enable him to better understand science without the aid of a science teacher? Perhaps secondary students should be provided an opportunity to work with scientists in universities and industry. Also, time should be allowed to give students a chance to do some creative work on their own at the high school level. It

is apparent that courses dealing with the meaning of science and the interaction of science and culture could be of value. Perhaps the most important question is how can science teachers at all levels, elementary through university, better convey their understanding of science to their students?

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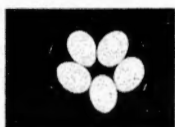
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