

Who's Teaching Chemistry in Indiana High Schools?

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Introduction

"The crisis in precollege science and mathematics education — so much in the news just four years ago — is over (7)." When I saw that statement I was very upset, but as I read the article, "Crisis Passes but Problems Remain For Precollege Science and Math," by Ward Worthy in the March 10th issue of *Chemical and Engineering News*, it became clear that Mr. Worthy was not serious about the problems in science and math education having been solved. In fact, since a crisis, by definition, does not drag on, the crisis must be past. However, I think nearly everyone will agree that the problems that provoked the crisis have not been solved despite quite a bit of press to the contrary.

Consider, for example, the kind of information that has been supplied to the American public. According to a table presented in the *Chemical and Engineering News* article but provided by the National Center for Educational Statistics in 1984, the shortage of chemistry teachers is only 1.9 per 1000 teachers and only 4.1% of all the chemistry teachers were not certified in 1984 at the secondary level (7). One does not consider this information to be too alarming at first. In fact, there does not appear to be much of a shortage or reason for concern. However, according to Mr. Worthy's article, perhaps there is no shortage of teachers in the classroom, but the question of competence in the classroom remains a big issue.

In July, 1986, the department of curriculum and instruction in the school of education at Indiana University published the results of the "Indiana Needs Analysis Project (1)." According to this survey 97.3% of the chemistry class sections are currently being taught by certified teachers. My question is, what does certified mean? The more I read and talk to various people, the more confused I become. Are these teachers certified in chemistry? If they really are certified to teach chemistry, are they qualified?

The executive summary of the Analysis Project indicates that certification does not necessarily mean that the teachers are qualified to teach chemistry. In fact, many of the principals interviewed by telephone admitted that some of the teachers would be replaced, if qualified applicants were available. As the report stated: "There are no data on the extent to which certified teachers are highly effective and thus conclusions about teacher certification do not imply any conclusions about the quality of instruction in Indiana (1)." Mr. Worth's article points out that about one-third of the science classes are being staffed by teachers who would otherwise be out of a job due to declining enrollments. Physical education teachers were mentioned as a large percentage of these "certified" teachers (7).

Most of the reports that have been published, such as the "ACS Report of the Task Force for the Study of Chemistry Education in the United States," indicated the need to strengthen the science curriculum in both elementary and secondary schools (5).

International studies such as the one reported in March, 1986, show the need for improving the math skills of our student population (6). American students scored lower in mathematics than those from a dozen other industrialized nations. "Americans only outperformed students from third world countries and Sweden (6)." The testing took place in 1982, but some of the results had still not been released when the article appeared in the newspaper. A quote from U.S. Secretary of Education, William Bennett, points out the problem: "It is distressing that our top kids (the test was administered

to the top 5%) would come in last. But our children are capable. It's a question of what we are giving them, what they are studying? The Japanese don't use some sort of magic. They work harder at it (6)." I feel that the same situation exists in chemistry because we are experiencing similar problems with the quality of instruction.

Obviously, the need for improvement has been recognized. Governor Orr must be aware of the problem because, according to a newspaper article in November, 1986, he is advocating lengthening the school year (3). However, increasing the number of days in class is not going to solve the problem unless the teachers are qualified to teach in their subject area. In fact, the international study showed that American students are already receiving more hours of instruction than their counterparts in other countries (6). The curriculum in Japan and other top scoring European nations is more extensive and faster paced than in America but this requires qualified instructors.

Some people must recognize this fact because the position statement presented by the National Science Teachers Association suggests that "a minimum of 50 semester hours of coursework in one or more of the sciences, as well as supplementary study in closely related areas such as mathematics, statistics, and computer applications, should be required for preservice secondary science teachers (4). If one reads this carefully, it is obvious that even this statement is not strong enough. Suppose a student takes 24 hours in chemistry, 15 hours in biology, and 11 in geology, physics, or some other earth science. Even worse, suppose he/she takes 24 hours in biology, 15 in chemistry, and 11 in some other science. If I am correct in assuming that certification, even now, only requires 24 hours in a primary area and 15 in a supporting area and that one can teach in one's supporting area, then this means that chemistry can be taught by an education major with a primary area in biology and a supporting area in chemistry. Theoretically one can teach chemistry in high school having taken only two semesters of general chemistry and one or two semesters of organic chemistry. Since organic chemistry, if it is presented, should be a very small part of the first year of high school chemistry, the teacher is trying to teach high school chemistry having had essentially only general chemistry in college.

Results

The results of a survey that I conducted this past spring lead me to believe that this is typical about 50% of the time. Mailing the survey to 400 schools resulted in response from about 120 teachers. As one might expect, the majority of the responses were from males (78%) and from public high schools (89%). Most of the respondents had advanced degrees. As can be seen in Table 1, thirty-seven percent had a Master's degree and 15% had a Master's plus from 1-15 hours additional course work.

Looking at the years of teaching experience in Table 1, one finds that the responses were somewhat evenly distributed between respondents who had been teaching from 6-10, 11-15, and 16-20 years with slightly fewer from those in the 21-25 year category. The smallest percentage of responses came from the teachers who have been in the profession for 1-5 years. Although one cannot draw too many conclusions about the number of teachers actually in these categories, Mr. Worthy's article tends to substantiate the conclusion that many of our current science teachers are nearing retirement.

Only 37% of the respondents (Table 1) have degrees in chemistry. However, it is difficult to quantify what a degree in chemistry means. Some of the respondents indicated that they had a degree in chemistry when they had only taken approximately 20 hours of chemistry. Obviously, some of them listed a degree in chemistry when they probably had a degree in education with a primary or supporting area in chemistry.

Approximately 50% of the respondents indicated that they had taken a physical chemistry course. Unfortunately, they did not always indicate whether it was a one-semester or two-semester course or whether it was at the graduate or undergraduate level. Looking at the response leads one to believe that many of the respondents either took a one-

TABLE 1. Respondent Histories

	Degrees (Percent)	Years of Teaching (Percent)	
BS or BA	4.6	1-5	9.0
plus 1-15 hrs.	5.6	6-10	20.7
plus 16 or more	21.3	11-15	18.9
MA or MS	37.0	16-20	19.8
plus 1-15 hrs.	14.8	21-25	16.2
plus 31 or more	11.9	25 plus	15.3
ABD	1.9		
	Degree (Percent)		
Chemistry	50.6		
Biology	30.4		
Other	19.0		
	Degree of Respondent Teaching First Year Chemistry		
	Present (Percent)	Future (Percent)	
Chemistry	50.6	45.0	
Biology	30.4	27.5	
Other	19.0	27.5	

semester course or a two-semester course which was the equivalent of undergraduate physical chemistry, but they received graduate credit.

Assuming that all the respondents who said that they had a degree in chemistry really did, then approximately 51% (Table 1) of the first year chemistry courses and only 62% of the second year or advanced chemistry courses are being taught by people with a chemistry degree. The situation will deteriorate as the new science requirements are met. According to the survey, the percentage of first year courses that will be taught by people with chemistry degrees will fall to 45% next year (Table 1). Obviously, some people have already been told that they will have to teach chemistry in the future.

Questions concerning attendance at workshops, seminars, summer institutes and industrial experience revealed that about 52% of the teachers had attended seminars and workshops and that about 52% had attended summer institutes. A few of the teachers had some industrial experience.

Discussion

According to a newspaper article in September, 1986, a coalition of some of Indiana's largest teacher education schools have agreed that undergraduate teacher education programs should not be moved to the graduate level as suggested by recent national studies such as "Tomorrow's Teachers" and "A Nation Prepared: Teachers for the 21st Century" (a report of the task force on teaching as a profession) (2). If students were allowed to take most of their education courses in graduate school, then they could devote more of their time in undergraduate school to learning the subject matter in their primary and supporting areas and would be better prepared to teach these subjects. Given the evidence of the sad state of science education in this country, it is difficult to understand why these teacher education schools are opposed to the idea!

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