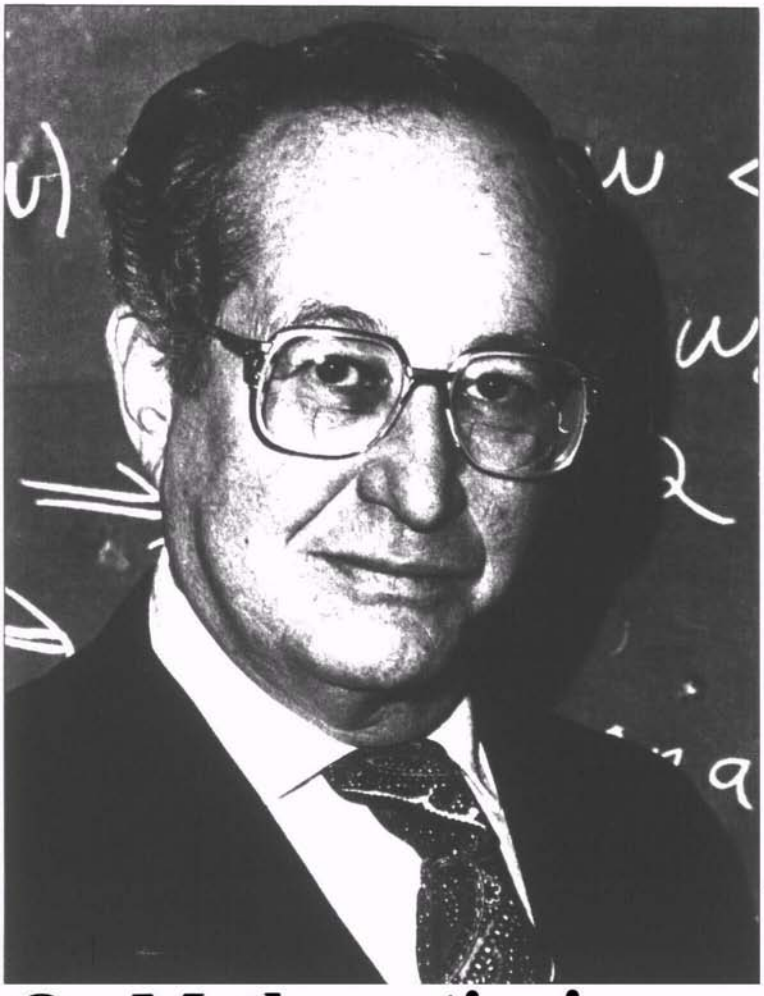

On Mathematics in the U.S.S.R.: A Conversation with Izaak Wirszup

University of Chicago Mathematics Professor Izaak Wirszup has attracted national attention by claiming that the Soviets have launched a massive drive to provide an unprecedented level of technological education to their entire populace. In this interview with Executive Editor Ron Brandt, Wirszup explains why he believes science and mathematics programs in the U.S. must be improved.

Q: What is the source of your information about education in the Soviet Union?

Wirszup: I have been closely following developments in Soviet mathematics and science education for over 25 years. My latest findings are based on thorough examination of the curriculums, text materials, monographs and books on teaching methods, periodicals intended for teachers, students, and the general public, and on graduation examinations from secondary schools and entrance examinations to institutions of higher learning.

Q: Your report says 98 percent of Soviet students graduate from secondary school or the equivalent. How do you know these statistics are accurate?

Wirszup: Most experts on the Soviet Union came to the conclusion in the 1950s that Soviet statistics on education are very reliable. We have additional information—the number of copies of textbooks printed, for example—that corroborates their assertions. These statistics are not published for foreign consumption, and they can be assumed to be uninflated.

Q: What do you consider the greatest deficiencies in U.S. mathematics and science education?

Wirszup: According to data from the National Science Foundation,[1] over 75 percent of our population is taught arithmetic for *nine years* or more. For the first six to eight years, they are taught by elementary teachers, the majority of whom have received no special training in mathematics. I strongly believe that spending nine of a child's formative years, which are so decisive in his or her total intellectual development and outlook, on boring arithmetic, on drill, is a terribly damaging experience to American youngsters. In most cases it leaves them with a negative attitude for life toward mathematics, and with feelings of incompetence and inadequacy whenever they are confronted with mathematics and science.

The Russians, on the other hand, have promoted close cooperation

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among mathematicians, teachers, educators, and methods specialists. Using their own advanced research in the psychology of learning and teaching mathematics, they cover arithmetic proper in grades one through three and complete arithmetic and even start algebra in grades four and five.

Soviet general elementary school teachers for grades one through three get extensive training in mathematics —five years of algebra, ten years of geometry, and calculus. However, from grade four on, all Soviet children are taught by specially trained mathematics teachers, whose mathematical background is at least equivalent to that of a master's degree program at any U.S. university.

Another extremely harmful feature of our school mathematics programs is that only about half of our students take geometry, and for only one year, generally in a concentrated high school course. Students cannot be expected to master the material taught in this way. Moreover, they are not being taught solid geometry, and they rarely have a workable perception of three-dimensional space, which is so essential for studying science, technical drawing, or engineering. Soviet children study geometry extensively for ten years, including two years of solid geometry.

Russians require their youngsters to study differential and integral calculus, because they consider it an essential part of a general education in the age of science and technology. Less than 4 percent of our own high school students take a calculus course.

Concerning science education, I think it suffices to say that of our high school graduates, only 9 percent receive one year of physics, 16 percent one year of chemistry, 45 percent one year of biology, and 17 percent one year of general science.

Q: The Soviet curriculum is strong in mathematics and science, but it is very limited in some other areas, isn't it?

Wirszup: Right. The Soviet school curriculum is strongly biased in favor of science, mathematics, and technology. This reflects the aims of the Communist Party and the Soviet government, which recognize the need for scientifically and technologically competent industrial and military power.

But much emphasis is also placed on the study of the Russian language and Russian literature, foreign languages (generally six years), and geography (five years). Other aspects of the social sciences are slighted or entirely absent at the secondary level. There is a brief (one hour per week) course in Soviet state structure in eighth grade, and tenth graders get a two-hour-per-week social science course that is essentially the history of the Communist Party.

Q: The curriculum you describe seems very unrealistic to many Americans. How do the Soviets get students to study such difficult material?

Wirszup: Students who cannot handle the rigor of the full general education course in grades nine and ten go primarily to technical-vocational schools, but while these students pursue their vocational training, they are required to continue taking classes at the general education school. What secondary school students take in two years, technical-vocational students may take over a period of three or four years; they study it more slowly, and they do it at a time when they are more mature and ready to learn. Even so, we cannot expect that all of them complete the sophisticated general education requirements to the same extent.

There have been reports that, especially during the first years of the "educational mobilization," some students graduated who had not completely mastered the more theoretical subjects. However, by simultaneous study in the vocational schools, they still got a lot of industrial and technical training, so they were well prepared to enter the labor market.

While the curriculums and text materials are the same for the entire Soviet Union, there are nevertheless differences between the level of performance found in urban centers and rural areas, and between the European part of the U.S.S.R. and its Asian republics. This is due primarily to variations in the cultural backgrounds of both teachers and pupils. But these differences are not too great at the pre-university level, and they are certainly not as great as between, say, inner city schools and suburban schools in the U.S.

Another consideration is the differences between our systems of government. Theirs is, of course, an authoritarian system, a dictatorship, very hierarchical, bureaucratic, and elitist. This is strongly reflected in the educational system. The social pressures for success in education are very high, so the students are highly motivated. Children are taught from the earliest age that the only way to be successful is to get as much education as possible, and since the educational system is integrated into the Soviet economic planning system and functions as a selection mechanism for *all* jobs, this is an absolutely valid lesson.

Q: You seem to pay particular attention to the expansion of training programs in the Soviet Union. What is the significance of these programs in the context of U.S. education?

Wirszup: First of all, comparatively, there is no U.S. counterpart with the range and availability of the training programs the Soviets have devised. Secondary vocational and technical education in this country lacks both prestige and appeal and has long been the poor relation of more strictly academic studies. It is reserved, where it is available at all, for students who are no longer expected to compete academically.

This means there are millions of students who are being shortchanged, thrown out on the job market with no skills and little chance of finding jobs. Consequently, industry is picking up much of this burden. It's a huge expense, and a task business is not best qualified to handle, but they're desperate for trained workers, so they have to do it themselves. I might add that the problem for the armed forces is even more severe, especially when you consider that most volunteers either have not completed a secondary education or have not adequately mastered their high school programs.

Q: How might training programs in the U.S. be improved?

Wirszup: The next 20 years will see a number of changes in the demography of the school-age population in the United States. A greater proportion will come from our minority populations, and these students will need more programs and better conceived and better managed

programs if they are going to have access to full educational and professional opportunities. It would be advisable, for example, to develop extensive cooperation between the various levels of the system — secondary schools, two-year colleges (the most logical place to develop or extend vocational and technical training, I might add), technical institutes, colleges, and the universities.

In addition, our bias toward a traditional kind of academic training as being the most desirable for every student is clearly inappropriate and, indeed, detrimental for many students. It should be possible, for example, to teach non-college-bound students more mathematics than they now receive without placing them in a curriculum designed for college preparation.

There can be much more communication between the schools and industry—establishing requirements for training, making students aware of what will be expected of them once they leave school, and arranging for shared use by schools of specialized industrial facilities and equipment.

Q: Which features of Soviet education can or should be adopted in the U.S.?

Wirszup: Our democratic philosophy is that education serves individuals by giving them the skills needed, and so the opportunity, to choose their life's work, to function freely in their society. The Soviet philosophy is that people are educated to serve the needs of the state.

So, in spite of their tremendous achievements, I would not advise imitation of Soviet goals or practices. I hope that by studying the Soviet and other advanced educational systems, and by analyzing weaknesses in our own programs, we can be stimulated to devise improvements appropriate for the U.S.

We should also be proud of our educational strengths. Our civil education is unlike that of any other nation; we really do teach our students to think for themselves. We are still the world leaders in science and technology, overall, and the graduate programs in our major universities are still the best anywhere. But our scientific and technical elite is relatively small, and our leading position has been eroding in the past decade. It takes a long time to develop a scientist, and it starts in elementary and secondary school, where our programs for the great majority of our students are weakest.

Q: If their goals and practices are not appropriate for U.S. education, what can we learn from the Soviets?

Wirszup: The most important lesson, political and ideological issues aside, is that the Soviet educational system is now designed to maximize the utility of *every* student—regardless of his or her ability, motivation, or stamina. The curriculum can be extended for a few additional years in combination with technical-vocational studies, or education can be carried on in tandem with a job or through evening or correspondence schools. But the expectation remains that every student will eventually pass through the compulsory curriculum without lowering educational standards.

It is precisely in this respect that U.S. schools can come in for the most criticism. For several reasons, only a minority of our students take full advantage of the benefits our school programs can provide. Average students in average schools suffer from diminished standards of achievement, a narrowing selection of educational alternatives, an almost complete lack of professional orientation, and an absence of support for continuing education once they leave the school system, even if they have the basic skills to make use of what is available.

Another word on programs. The programs we have for our gifted students—where we have them at all—are painfully insufficient. Ideally, these are our future leaders in every field, but we do not equip them for such responsibility. Gifted students are all too often allowed to manage alone under the misguided belief that their natural abilities will see them through or that there is something questionable in the notion that they deserve special attention. The Soviets see no contradiction or inconsistency in their social theories in a school system that offers maximum education to the many while striving, at the same time, toward the training of the most able to elite positions in science, technology, and the military.

The political and social structures of the Soviet Union and the U.S. are so different as to make adoption in this country of a Soviet-style educational system impossible, let alone desirable. But there can be an American alternative with the same purpose—to make high quality education available, and to *deliver* it, to all American students.

I believe that our society can convince itself of the urgency of vigorous reform and improvement of our educational and manpower training programs. Investments in our own human resources are essential to the well-being of all our citizens and necessary for the revitalization of the nation's economy and defense. ■

[1] The NSF studies were summarized in articles in the February, March, April, and May 1979 issues of *Educational Leadership*.