Zeitschrift: L'Enseignement Mathématique
Herausgeber: Commission Internationale de l'Enseignement Mathématique
Band: 5 (1959)
Heft: 4: L'ENSEIGNEMENT MATHÉMATIQUE

Artikel: SCIENTIFIC FOUNDATION OF MATHEMATICS ON THE SECONDARY SCHOOL LEVEL
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DOI: https://doi.org/10.5169/seals-35499

SCIENTIFIC FOUNDATION OF MATHEMATICS ON THE SECONDARY SCHOOL LEVEL [1])

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(Reçu le 15 octobre 1958.)

This topic suggests a general discussion of the principal forces determining secondary school mathematical curricula. These forces, as far as American education is concerned, include (1) inertia, (2) mass education, (3) local control of the schools, (4) scientific and technological developments, (5) organized efforts to influence school programs.

1. *Inertia.* Traditional courses tend to persist because *(a)* they are embodied in textbooks; *(b)* they are transmitted from one generation to the next by familiarity and by the persistence of teacher training programs; *(c)* entrance requirements of colleges change slowly and determine part of the secondary school curriculum; *(d)* the school system is so large and its parts so interrelated that only slight local changes can be made without creating serious difficulties for both students and teachers.

2. *Mass education.* During the past few decades, the tendency of Americans to go farther and farther in school has led to a situation where almost everyone, as a matter of course, completes a high school program. (The terms "secondary school" and "high school" are synonymous.) The schools have accordingly adapted themselves to students with all levels of ability and with every type of intellectual or vocational interest. This has, in many instances, involved the development of courses in the practical mathematics of everyday life for students not preparing for college or engineering school. In other

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[1] A report presented at the International Congress of Mathematicians, Edinburgh, Scotland, August, 1958.

instances, the presence of large numbers of such students has tended progresssively to weaken the regular mathematics courses. The increasing shortage of well-qualified teachers and, perhaps, a widespread misinterpretation of democracy have made it difficult to develop special courses for students of superior ability. The increasing level of education in the general American population has tremendous social and economic value. Only a small minority of Americans would like to return to a system of high schools dedicated almost exclusively to those with strong academic interests and ability. Many of us, however, have long advocated special efforts to develop the potentialities of superior students. A recent sharp increase in both public and educational support is leading to genuine progress in this direction.

3. *Local control of the schools.* One phenomenon distinguishing the American school system from that of most other countries is that the schools are primarily governed by local boards, who select superintendents and exercise control over the hiring of teachers, the educational offerings of the schools and many other services and activities attached to the public educational system. There it strong resistance to any effort to centralize control at the state level, and fierce resistance to any tendency toward federal control. While the situation varies from state to state, it is fair to say that, although everyone is required to go to school to a certain age, there are few laws requiring the schools to offer any particular type or level of instruction. Depending on local conditions, such as the economic and cultural level of the community, a secondary school program may be academically strong or weak. Some high schools offer excellent preparation for college courses commencing with calculus and analytic geometry. Indeed, certain of them even offer good beginning calculus courses. On the other hand, large numbers of students enter college with seriously deficient mathematical preparation, in some cases because of inadequate schools, in others because of poor counselling or poor motivation. As a result, most colleges offer courses, not necessarily for credit, at essentially the high school level for those who need to make up mathematical deficiencies.

4. *Scientific and technological developments.* In general, modifications in mathematics courses come slowly, as textbook writers gradually introduce new topics and leave out others. Publishers tend naturally to favor textbooks which are sure to be adopted by a reasonable number of schools, and radically new material makes excessive demands on the general run of teachers. Nevertheless, the cumulative effect of small changes is such that the mathematics books of today are noticeably different from those of a generation ago. There is, for example, a tendency away from the traditional stereotyped courses in euclidean geometry and from some of the routine computational aspects of trigonometry. There is also a move to introduce elementary material on probability and statistical inference. Recent events have created a strong public interest in the training of scientists and engineers and in strengthening the schools, especially in the area of mathematics and science. It is highly probable that the influence of this aroused interest will be reflected in a reformation of mathematical instruction.

5. *Organized efforts.* Organizations of mathematicians, teachers of mathematics, scientists and educators are continually engaged in efforts to improve mathematical education. For reasons indicated in the first three numbered paragraphs above, such efforts generally lead to only slow evolutionary changes. For other reasons noted above, however, there is now hope for more rapid progress in the adoption of curricular improvements. Since the program of the Congress includes reports on some of the principal current American efforts to improve mathematical education, no detailed discussion of them is included here.