

## VIEWS ON MATHEMATICS EDUCATION IN SINGAPORE

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When one views mathematics education in Singapore objectively and in its entirety, and asks the questions, "Should the system of mathematics education in Singapore be geared towards producing brilliant mathematicians?" The answer is a definite no, at least not in this decade. The present system of mathematics education in our schools provides an adequate foundation for such students. These students may show their interest or talent in mathematics at the early age of 13 though usually it is around 15 years old. As a rule, they are highly motivated and they would on their own volition read books on mathematics and solve a lot of problems. What they do need is guidance, encouragement and good library facilities.

The Public Service Commission offers a generous number of scholarships to universities abroad as well as locally. Some of the best students are admitted to Oxbridge universities and in each year these usually include one or two future mathematicians. As for the outstanding mathematics students at the National University of Singapore, they will invariably be spotted by the lecturers. They are then taken under their wings and on graduation are given every encouragement to pursue postgraduate studies locally or abroad.

A future mathematician usually knows that the pursuit of mathematics will give him great satisfaction and fulfilment in life and is motivated towards this achievement. For him and people like him, there is no problem as their future is well-mapped out. However, there are others equally gifted, who are encouraged or enticed to pursue one of the more glamorous professions such as engineering or medicine. Each year, Singapore has lost a number of would be mathematicians in this manner and it is a problem we have to find a solution.

Assuming that the Republic produces in a year an average of ten to fifteen mathematicians with postgraduate qualifications, this is only a minute figure compared with the much larger number of students studying mathematics at the various levels of education. This brings us back to our original premise that we cannot afford to gear our education system towards producing brilliant mathematicians. After we have dismissed this group of students, we are left with two other groups, which mathematics education has to serve. The first is the group of mathematics teachers and the second group, which covers a very wide spectrum, consists of people who require mathematics as a tool in their daily lives.

Mathematics is a compulsory subject in primary and secondary schools. Though everyone has accepted the fact that mathematics must be taught in the primary stage, there are still some who advocate that Mathematics should be an optional subject for the GCE 'O' level examination. This is an erroneous approach. The demand for a mathematical background to cope with the society in which we live is always increasing and has never diminished. Coping with price variations and percentages are everyday problems. Our income tax forms are becoming more complicated. We should be able to question a set of statistical data presented to us and not to accept it

as the gospel truth. Singaporeans are reputed to be both pragmatic and materialistic. Though mathematics does not teach us how to accumulate wealth, it is one of the tools towards achieving it. We are moving into a stage in our society where computers will play an increasingly more important role. We must have the ability to understand that role, to cope with it and to benefit from it.

Having established that mathematics is an indispensable subject in school, as important as the need to study two languages, the next step is to have this fact ingrained in the minds of students, parents and teachers and to have it accepted by them. Since mathematics is indispensable, the next question is : How should mathematics be taught in schools so that it is interesting, useful and is applicable in our everyday lives ? This question is asked in most countries in the world at one time or other. In the primary school where mathematics is elementary and full of common sense, a great deal will depend on the teacher's method of teaching, his perception of mathematics and his attitude towards mathematics and the children under his charge.

It is a fallacy to believe that this is not an important stage in the mathematics education of a child. In fact its importance cannot be over emphasized. If a child is good in mathematics in primary school, the probability of his maintaining his performance and interest in secondary school is high. One seldom hears of a child weak in mathematics in primary school, who has this trend reversed in secondary school, unless his areas of weakness have been promptly recognised and rectified. Mathematics is a highly structured subject, where each level depends heavily on the knowledge of the previous level, so teachers at each level must be fully conscious of the responsibility and importance of their role.

In the New Education System for Primary level, students are streamed in Primary Four to the Normal Bilingual, Extended Bilingual and Monolingual Courses. If this streaming coincides with mathematical ability, then the extended courses will provide the slower students sufficient time to establish a firm foundation in primary mathematics before moving on to the secondary school or the vocational institute. As mentioned earlier, such foundation is of great importance not only to students in secondary schools but also to those undergoing vocational training.

The article on vocational and industrial training relates how specific objectives in mathematics learning which are necessary to the engineering trades are pinpointed and carried out. A student, who has acquired the fundamentals of mathematics in the primary level and to a certain extent in the secondary level, will not only find the mathematics courses in the vocational institutes interesting but will be able to develop certain initiatives of his own towards the application of mathematics to his chosen vocation.

Like the primary mathematics teacher, the secondary school teacher must be made fully aware of the broad objectives of mathematics education and should familiarise himself on the background of the students as well as how they are going to use mathematics in future. Certain priorities and emphases have to be set. Just as it is disastrous for a primary teacher to mark a correct solution wrong because the student has not conformed to his way of solving the solution, so it is equally disastrous

for a secondary teacher to mark a solution incorrect simply because it is an alternative solution which has not been taught.

The next stage of streaming in the education system is based on the results of the Primary School Leaving Examination (PSLE), where students promoted to Secondary One are streamed into the Normal, Express and Special Courses. Students in the Normal Course will sit the Certificate of Secondary Education (CSE) examination at the end of four years and for those who have performed well, they will be allowed to sit the GCE 'O' level examination at the end of their fifth year. The Express and Special Courses are for abler students who will sit the GCE 'O' level examination in four years. As mathematicians, we hope that the streaming of students into these courses run parallel to their mathematical ability. If students weak in mathematics are streamed into the Normal Course, they will have a chance to rectify their areas of deficiencies and to acquire a firmer foundation in mathematics education at a pace more suited to their abilities.

It is heartening to note in Dr Kho's article on "Mathematics Curricula in Schools" that a uniform syllabus is being introduced in all secondary schools. This syllabus is the GCE 'O' level Mathematics Syllabus D, and its implementation commences with Secondary One in 1981. For many years, mathematics teachers in various institutions receiving students from the schools have not only to resolve the problem of the varying levels of mathematical achievement among the students but they also have to cope with the diversity of the mathematical background of the students. Some students will be taught Mathematics Syllabus B, which embraces traditional mathematics, whilst others Mathematics Syllabus C with its emphasis on modern mathematics.

Both Singapore Polytechnic and Ngee Ann Technical College offer three-year Diploma courses to 'O' level students. Lecturers in both institutions encounter some difficulty in pitching the level and content of mathematics in the first year. Students not only have varying grades in Mathematics in their 'O' level, but many have also passed Additional Mathematics. Students in schools who are inclined towards the engineering and technical fields should be given every encouragement to offer Additional Mathematics. In this manner entrants to these institutions will have a uniformly high level of mathematical attainment. The 'A' level students are admitted to the second year of the Diploma course.

The role of mathematics education in the vocational institutes, Ngee Ann Technical College, Singapore Polytechnic and the Engineering Faculty of the National University of Singapore is distinct and definite. Mathematics is a tool to aid and strengthen a student's knowledge in his chosen profession. There are numerous other disciplines which require varying levels of mathematical knowledge. For instance, a scientist or economist will need a higher level of mathematics than a lawyer.

Mathematics taught in schools and the University has to cater to students of multi-disciplines. It is therefore necessary to emphasize on basic courses which usually have wide applications. The final product would be a student who has not only acquired the fundamentals of mathematics but is also able to pick up whatever further

mathematics he needs in his particular kind of work. Furthermore, he would be able to think mathematically which is also synonymous to thinking logically and rigorously.

The Department of Mathematics of the University is revising its mathematics courses to suit the needs of the increasingly large number of students reading mathematics in the Faculties of Arts and Science. In the academic year 1980/81, 597 students read mathematics in their first year and out of this number less than a quarter will probably major in mathematics. The revised courses proposed by the Department are so designed as to enable the larger group of students, who require mathematics as a service subject, to attend mathematics courses where the emphasis is more on methods and applications. At the same time, the smaller group specializing in mathematics is not neglected. Courses with more emphasis on abstraction, mathematical rigour, concepts and theory are available to suit their requirements.

A large number of graduates who major in mathematics join the teaching profession. In contrast to the group of people who may restrict themselves only to certain areas of mathematics useful to their profession, a mathematics teacher's knowledge of the subject has to be much more than what he is required to teach. Besides he has to possess certain intangible qualities such as a firm grasp of the subject, an ability to perceive relations and linkages as well as the ability to explain the subject at the students' level. This latter quality is of paramount importance to a teacher because mathematics consisting of concepts, symbols and figures has a language of its own. A graduate teacher schooled in university mathematics has to explain the subject in simpler and more concrete terms to students in secondary schools. This ability, which is often overlooked and taken for granted, is difficult to attain and as a result, many teachers teach the subject pedantically or in a manner that the average student finds difficulty in understanding. The standard of mathematics in any place can be equated to its standard of teaching. In Singapore, good mathematics teachers often possess administrative abilities as well. This is unfortunate, as a number of very capable mathematics teachers who could contribute so much to mathematics in Singapore have been promoted into the more lucrative and glamorous administrative positions.

It is natural that a mathematics teacher's main concern is on the courses in which he teaches. It would be more rewarding for him if he knows how his teaching would benefit his students in the future. In mathematics education, there is a dependency and inter-relationship among the various institutions in Singapore. Occasionally, mathematics education in Singapore should be viewed in its entirety so that improvement can be made not only within the institution but also from the standpoint of one institution aiding and strengthening the other. In this manner, mathematicians in Singapore can create their own mathematics tradition instead of letting tradition take its own course.