MOFET Structured Teaching Methods on a 12-Year Continuum

The success of any pedagogical activity depends largely on a systematic approach that focuses on achieving the desired results. This principle plays an important role in teaching, yet the primary drawback of the teaching methods that currently pervade Israeli schools, and which impact the quality of mathematics in particular, is the absence of a consistent, commonly accepted level of readiness for the transition to a more advanced stage in learning. This is particularly evident in the transition from the elementary school to the middle schools, and then again in the transition from middle to high schools. As a result, there is no solid foundation for the study of mathematics, which would enable students to move to the next level. The principle difficulty encountered by students is not related to the study of new materials, but is the result of their experience with previously studied subject matter.

In order to offset these problems and to provide students with a solid knowledge base, particularly in mathematics, MOFET has developed a specialized methodology with the following objectives (1):

- Development of curricula based on a tight connection between objectives, content and methodology across the school years, from elementary through high school.
- Stringent selection of MOFET teaching staff, and the development and advancement of the teacher through in-service training.
- Organization of the learning process, including adaptation according to the age, personal abilities, maturity and individual interests of students.

This paper addresses each of these objectives.

The primary objective of mathematics instruction on all three levels (elementary, middle and high school) focuses on the acquisition of structured mathematical knowledge and skills, concrete and abstract, which are required in everyday life and in the "real" world of employment. The objective is to provide students with the skills necessary to enable them to undertake the study of interdisciplinary subjects.

According to Boris Kvitcho (2), the MOFET program aims to:

- Develop the skills of each student
- Familiarize youth with the sciences
- Emphasize the study of science as a tool in developing the creative potential of each student
- Foster a positive attitude toward the study of mathematics and the sciences

Kvitcho maintains that MOFET strives to achieve a high level of education while taking into consideration the abilities of its students. Starting at the earliest age, emphasis is placed on developing study skills, as well as on shaping and developing motivation at each stage in the school system.

The priority of each objective changes in each stage. Thus, the primary objective at the **elementary school stage** is to develop study skills as a tool to structuring learning goals and achieving them. For example, identifying and defining the problem, investigating data, identifying the actions best suited to achieving the goal, critiquing and evaluating them, reflection, and so on.

The study of mathematics plays an inseparable part in the expansion of student's horizons and the development of general study skills. This can be explained by the fact that mathematics enables the learner to consciously and independently find solutions to multi-dimensional problems in a wide range of practical areas that are related to the world of numbers per the following scheme:

Objective ⇨ Build mathematical model ⇨ Solution ⇨ Check validity of solution

This learning process is effective only if the student is able to solve the problem, not only by using the scheme but also through a conscious understanding of its use.

At the **middle school stage**, the primary objective is the study of mathematics as a subject. The tools acquired in the elementary school (general learning skills) serve as the basis of learning at this stage.

At the **senior high school stage**, priority shifts to the professional interests, capabilities and inclinations of the students. The primary basis for study at this stage is the synthesis of the skills they have acquired in the various subject areas (which are important to the study of each and every subject), fluency in the language of mathematics (an integral part of the learning process and data process in every subject), and the mathematical knowledge acquired by students in the two previous stages (in the elementary and middle schools).

The learning process in the MOFET classroom is based on the following general principles:

- Motivating students to excel in the sciences.
- Using the study of mathematics as a key tool in developing students' creative and logistical potential.

The MOFET program in the elementary school aims to raise student motivation in preparation for participation in MOFET classes in middle school. According to Boris Kvitcho (2), although a significant portion of the highly motivated students have strong intellectual skills, this is not true of all motivated students. MOFET believes that with the proper motivation even so-called weaker students can succeed.

In each of the three stages, the level of difficulty of studies is relatively high for each student and is determined on an individual or class-wide level. MOFET classes are less heterogeneous than regular classes. MOFET classes provide an equal opportunity for all students who want to learn with a supportive education environment.

The MOFET approach to teaching mathematics in modern Israel is based on an understanding of the power of mathematics as a tool for creating models to describe phenomena and processes in science and in everyday life. The concept of mathematics is a basic language not only for teaching science, but also a universal tool for the acquisition of knowledge about the world in which we live.

The importance of the study of mathematics manifests itself in the process of admissions to all institutions of higher learning. Great importance is attributed to the student's average grade in Israel's Matriculation examinations. This situation reinforces the importance of teaching mathematics in the Israeli school system as well as the role of MOFET as a proponent of the study of mathematics in all three stages of school (elementary, middle, and high school). The principle of continuity in education constitutes a critical condition for success and is put to into practice in the structuring of a program.

The MOFET program for the study of mathematics in the elementary school is structured according to four methodological lines: numbers; geometry; statistics; and logical/thinking challenges. These four lines are organized according to increasing levels of difficulty, from specific to generalization, from concrete to abstract. In the middle and high schools, additional methodological lines are added, including equations and inequalities, functions, differential and integral calculations. To create the proper continuity of activity, one should rely upon the skills acquired in the previously studied subject matter, and expand upon and advance one's skills by adding more complex tasks that constitute the transition from the specific to the general, and vice versa.

The program covers the subject matter included in the official curricula of the Ministry of Education, as well as additional topics recommended by MOFET. The program is presented in a way that enables teachers to teach the material in the most efficient manner. They can opt to spend less time on some subjects, while expanding on the curriculum with additional subject matter. Accordingly, the important focal points for elementary education are:

- The meaning of mathematical concepts, the connection between them, their continuity and their presentation according to the following methodology: We recommended that the following be emphasized:

    1. Basic concepts: sequential numbers, odd and even numbers, digits and numbers, single-digit and multi-digit numbers, natural numbers, whole numbers, fractions, rational numbers, totaling and addition,

differences and subtraction, factors and multiplication, divisors and division, and so on.

2. Correlation between natural numbers as outcomes of measurement and counting and units of measurement.
3. Transition from concept to concept in continuum and with gradual increase in level of difficulty. For example:

   a. Comparison of numbers (=, <, >) – the order of numbers – numerical axis – location of numbers on a numerical axis.
   b. Equal and unequal - decreasing and increasing – word problems – addition and subtraction, composing and solving equations.
   c. Structure of numbers – addition and subtraction - characteristics of arithmetic tasks – arithmetic rules – efficient ways of doing arithmetic tasks.
   d. Decimal structure – two-digit and multi-digit numbers – algorithmic mathematical activities – efficient ways of doing arithmetic tasks.

- Application of graphic representation in the elementary school as a universal tool in problem solving strategies, evaluating actions and their results.
  - On one hand, graphic representation shows the connection between sizes (area, length, volume, and so on) and the numbers that appear in word problems, and as the result of measurements.
  - On the other hand, graphical representation provides tangible representation of abstract connections, for example, part and whole, sum and total factor and multiple, and so on.
- In view of the connection and continuity between the material studied in the elementary school and the curricula studied in the MOFET classes in middle school, it is recommended that the following be emphasized:

1. Subjects that constitute a prerequisite for continued studies in the middle and senior high school, such as numerical axis, axis system, decimal structure, division marks, representation of simple fractions, motion and volume problems, sections and angles, solving of geometry problems that require preparation of diagrams, and so on.
2. Rules of arithmetic and characteristics of arithmetic activities that enable the solving of equations, starting from 1st grade.
3. Subjects that enable, from 1st grade, development of concepts related to finding patterns (different types of series, magic squares, combinations problems, and so on).
4. Subjects that enable representation of the connections between algebra and geometry (area, perimeter, construction of equations based on geometry).