

**VALUES IN MATHEMATICS
EDUCATION
(2/2)**

Brother Enrique García Ahumada

Formative value of social development

The Brothers train their students to adopt a critical stance towards contemporary society, particularly as regards the mass media and the many other technological resources that are part of today's world (Rule 13c).

Mathematics allows one to give precision to the knowledge of material reality, in which social reality is included to a certain extent. Students who are tempted to enclose themselves in the imaginary world of mathematical ideas need to open themselves to social realities in which there is much suffering and injustice. Interesting and even moving dialogues can be fostered among both family members and other persons while using real information in these problem areas.

In their educational activity the Brothers will be careful to help their students become aware of human suffering in its concrete forms.

They will strive to awaken in them an increasing sense of universal brotherhood (PP68); they will do all in their power so that the young who live in favorable circumstances understand that human solidarity and the Christian spirit invite them to share their goods and to serve those who are in need (Declaration 32.2).

A step forward in educational quality can be achieved if the students themselves discuss social problems based on their own interests, organize themselves to search for documentation, classify the information obtained, suggest determining quantitative questions with the guidance of the teacher, solve them with their scientific resources and then express their solutions choosing the beneficiaries.

As a witness to the Christian attitude of poverty and in an effort to develop it in others, the Brother is engaged in the struggle against the poverty of frustration (Declaration 30.1).

It is always possible and formative to suggest mathematical questions related to: the family and its number of members according to age groups; the family budget; the distribution of the family budget; rates of employment and unemployment; the distribution of income according to occupation and areas; value added tax and rental tax; geographic distribution of certain diseases; the expansion of epidemics and its sanitary neutralization; morbidity and mortality according to age groups and geographic distribution; housing and its expanse or the average number of inhabitants; the efficiency or inefficiency of social planning in specific areas; illiteracy and literacy rates among age groups and according to occupational types; migration from the

country to the city or between countries; delinquency and its socioeconomic conditioning factors for particular crimes; addictions; begging; the rate of diverse occupations (doctors, teachers, soldiers, priests) for each 1,000 inhabitants according to countries or areas within a country; distribution by blocks or square kilometers for certain services (pharmacies, bars, Catholic or other churches)...

Social attitudes that can be suggested as goals of mathematics education are, for example:

- a) *to evaluate* as desirable or undesirable quantified social, economic, cultural and religious situations;
- b) *to suggest* viable hopes with respect to researched demographic, socioeconomic or socio-cultural situations and described through various types of pictographs;
- c) *to commit oneself* against social situations that have been evaluated quantitatively as anomalous.

Ethical formative value

To open young people to life, to a sense of their responsibilities, to knowledge and to love, is already a way of accomplishing God's work since his Kingdom is built both by the activity of the Church and by work in the world (Rule 15c).

Moral attitudes are dispositions to work for good and avoid evil. Any healthy activity serves to develop the moral quality of the person, beyond his simple psychological maturity. The learning of mathematics gives rise to moral development, especially if the instructor and the student consider learning how to be a better person as one of their objectives.

The main moral attitudes that can be developed through the learning of mathematics are:

- a) *responsibility* manifested in the appropriate preparation of homework and evaluations; in more advanced stages of development, in initiatives to carry out methods and obtain knowledge without the need for evaluation nor supervision on the part of the teacher;
- b) *the love for truth*, not limited to practical applications of mathematics: to value the simplicity of principles, to delight in the perfection of logic being linked together in one's proposals, admiring the absolute validity of one's affirmations, becoming enthusiastic in the admirable coherence of different aspects;
- c) *honesty* in demonstrations; in the applying of principles for the solving of problems; in the transparent use of data and properties that are applied; in the persuasive force of deductions and verifications; in the objectivity to accept legitimate affirmation and to reject those which are groundless; and, last but not least, in the autonomous use of one's own intelligence during the evaluations;
- d) *constancy, patience and perseverance* required by the necessary exercises until one becomes sufficiently fluent in what he has learned.

Philosophic value

Apprenticeship that leads to mathematical knowledge tends to awaken in studious persons, whether they be students or professional people, an interest in other questions that go beyond the dominion of mathematics, in search of the meaning of all things: what relationship is there between algebraic symbols and reality? Are they just names with no real significance? Do animals give evidence that they understand numerical significance? What are mathematical entities such as a cube root or the determinant of an equation system? What link is there between definitions, axioms and theorems of symbolic logic, philosophical logic and rela-

tionships that are fulfilled in reality? What does the existence of mathematics have to do with real existence? What genre of reality does infinite mathematics have?

The curriculum for Mathematics instruction generally does not propose to awaken philosophical anxieties except when the educational program of a school requires it; but an educator who is open to other cultural avenues always guides the student to accompany him in the originality of his maturing. If he is trying to form persons and not merely experts or specialists, then opening access to other branches of learning is essential, even though environmental pragmatism may impede one to capture the sense of these gratuitous desires.

Mathematics is a limited field, it is not all of culture nor is it even the most perfect of all knowledge. It studies quantities, attributes of the material, which is not all of reality. A one-sided or erroneous mathematics education may not only impoverish affectivity and limit human relationships but even deform one's view of the world, as if everything that is intellectual could be reduced to exact relationships. Mathematical knowledge has much fewer nuances than philosophical knowledge. While in mathematics everything that can be demonstrated has the same degree of certainty, it is classic that in philosophy and in theology to distinguish between physical certainty, metaphysical certainty, moral certainty and assent for the probable which in its turn can have varying degrees. Mathematics is inadequate not only in the philosophic realm but also with regard to the area of esthetics, ethics and mysticism which lead one to what is beautiful, worthy and holy. Students need to open themselves to these very important forms of knowledge in order to have a full life.

Attitudes that are linked to the philosophical values of mathematics are almost the same ones that are indicated for their cognitive value and are only differentiated by their content.

Religious value

The spirit of faith kindles in the Brothers an ardent zeal for those confided to their care in order to open their hearts to receive the salvation revealed in Jesus Christ. This zeal, enlivened by the Holy Spirit, inspires their apostolic prayer and all the activities of their educational ministry. In this way they participate in the gospel mission of the Church. Through the promotion of justice and peace they cooperate in the building up of the kingdom of God (Rule 7).

All reality manifests something of the perfection of God, is penetrated by the divine presence and can help relationships with God. Science permits one to admire the supreme creating intelligence. For example, mathematics allows one to conceive of a universe of infinite dimensions, which our senses permit us to only capture three which shows the abyss between the possibilities of the created being and especially of the author and the finiteness of material reality in which the human being experiences his restrained condition of incarnated intelligence. Pierre Thuiller in his *Les passions du savoir* (Paris, Fayard, 1988) reflects on how mathematics may lead one to God.

In educational centers that foster the option of creed, whether they are Christian or not, the mathematics program should promote religious attitudes such as the following:

a) *admiration* for the works of God: to wonder at the order of the cosmos governed by mathematical laws; to admire human intelligence, gifted by a participatory creativity by God to discover exact relationships between diverse classes of real or imaginary beings; to be astonished when faced

with the regularity of possible infinite collections of numbers or geometric figures or logical connections;

b) *gratitude* to God; to thank God in silence or within the student community for intelligence, the creation of the cosmos and for myself, the exact structure of the universe, personal life and those of loved ones, the possibility to study and to educate oneself, parents and teachers and for so many other gifts;

c) *to offer* the present class, study and other activities to the ever-present God: to recall the presence of God frequently in order to honor God with words and with actions; to guide one's current studies for the service of God and one's neighbor; to carry out compassionate service or solidarity activities motivated by the knowledge of social needs;

d) *asking for* gifts in the name of Jesus Christ: to ask for his light to understand science and the way to use it well; to request favors for oneself and for those in need (especially the will to study instead of just asking for grades when one has not studied sufficiently); to ask for light to discover in one's personal vocation the best way to serve God and neighbor with science;

e) *sorrow* for bad actions: to ask for pardon for an ill use of intelligence or for not taking advantage of the possibility for study or for using science in such a way as to be against humanity or the poor or for an inflated ego that impedes helping those in need;

f) *to strengthen one's faith* (not to be confused with rooting one's faith) with anecdotes and sentences of believing scientists to show how faith is compatible with the scientific-technical culture.

The role of the teacher

The formative role and not just the informative role of the mathematics teacher demands that one keep these values very much in mind, that they exhibit a training that is based on a balanced personality, free of trauma, trust in the future, enterprising. It is necessary to continually cultivate self-esteem in young people and adolescents so as to avoid despondency when faced with repeated failure. These could have the result of making them permanently turned in on themselves at least in this aspect of their personality.

The mathematics class needs to have an atmosphere of mental hygiene where it is possible to discover and not just reproduce knowledge already known; where all have the possibility to understand all that goes on; where the brighter help the less gifted; where students are assessed in twos, threes and fours while at the same time one must not surrender one's individuality; where instead of a fierce despondency when facing an important area of culture, there is cause for the joy of mental games and a delight in learning.

In both basic and intermediate education it is possible to incorporate an experimental phase in the process of mathematics learning, where it might be possible to appreciate the significance of numbers or discover the pertinence equation points on the same curved or straight line, to verify with a ruler and compass the properties of figures, to use computer simulations and only then to connect these experiments with a logical argument of abstract relationships. In this experimental phase the students can venture a guess at definitions and point out properties using a provisional language. Here there is a greater need for stimulation than for critique.

Students recognize the importance of stated objectives when their achievement is shown on an evaluation. Therefore, the teacher needs not only to determine the results but also to observe the learning process. Effort also counts, not just exactness. It is educational to assess considered attitudes as desirable in the educational guidelines and not just knowledge, especially if the student is not brilliant in mathematics. In this way much innocent suffering can be avoided. •