

VALUES and the TEACHING of MATHEMATICS (Part 2)

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Ethical Formation

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. Moral attitudes are dispositions to work for good and avoid evil. Any healthy activity serves to develop the moral quality of the person, beyond a simple psychological maturity. The study 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:

- ❑ responsibility, manifested in the appropriate preparation of homework, in evaluation at the more advanced stages of development, in initiatives in finding methods for obtaining knowledge without the need for supervision on the part of the teacher;
- ❑ the love for truth, in the practical applications of mathematics but also in valuing the simplicity of the principles behind them, delighting in the perfection of logic in one's proposals, admiring the absolute validity of one's affirmations, becoming enthusiastic about the admirable coherence between different elements;
- ❑ honesty, in demonstrations, in applying principles for solving problems, in the transparent use of data, in the persuasive force of deductions and verifications, in the objective willingness to accept legitimate affirmations and to reject those which are groundless, and in the autonomous use of one's own intelligence during evaluations;
- ❑ constancy, in the patient perseverance required to do exercises until one becomes sufficiently fluent in what is being learned.

Philosophic values

Apprenticeship that leads to mathematical knowledge tends to awaken an interest in other questions that go beyond the domain of mathematics and into the search for meaning in 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 relationships 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 Mathematics curriculum generally does not try to awaken philosophical anxieties except when the educational program of a school requires it. But an educator who is open to other cultural avenues is always ready to accompany the student in the growth to personal maturity. If he is trying to form persons and not merely experts or specialists, then opening access to other branches of learning is essential, though admittedly not always easy. Mathematics is a limited field. It is not all of culture, nor is it even the most perfect of all knowledge. It studies quantities and the attributes of matter, which are 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 fewer nuances than philosophical knowledge. In mathematics everything that can be demonstrated has the same degree of certainty. In philosophy and in theology it is standard practice to distinguish between physical certainty, metaphysical certainty, moral certainty and probability in varying degrees. Mathematics is inadequate not only in the realm of philosophy but also in aesthetics, ethics and mysticism, which lead to what is beautiful, worthy and holy. Students need to open themselves to these important forms of knowledge in order to have a full life.

Religious values

All reality manifests something of the perfection of God, is penetrated by the divine presence and can help relationships with God. Science permits us to admire the supreme creating intelligence. Mathematics allows us to imagine a universe of infinite dimensions. Pierre Thuiller in his *Les passions du savoir* (Paris, Fayard, 1988) reflects on how mathematics may lead one to God. In educational centres that foster the faith option, whether they are Christian or not, the mathematics program should promote religious attitudes such as the following:

- 1) admiration for the works of God: wondering at the order of the cosmos governed by mathematical laws; admiring human intelligence, endowed with a participatory creativity enabling it to discover exact relationships between diverse classes of real or imaginary beings;
- 2) being astonished when faced with the regularity of possible infinite collections of numbers or geometric figures or logical connections; gratitude to God;
- 3) thanking God for intelligence, for the creation of the cosmos and for the exact structure of the universe, for one's own life and that of loved ones, for the chance to study and to educate oneself; offering to the ever-present God the present study and activities: recalling the presence of God frequently in order to honour God with words and with actions;
- 4) directing one's current studies towards the service of God and one's neighbour; asking for gifts in the name of Jesus Christ: for his light to understand science and how to use it well, for light to discover in one's personal vocation the best way to serve God and neighbour through science;
- 5) sorrow for wrong actions: asking for pardon for a misuse of intelligence or for not taking advantage of the opportunities for study or for misusing science;
- 6) affirmation of faith through stories of scientists whose lives and words show that faith is compatible with the science and technological 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. They are signs of an education that is based on a balanced personality, free of trauma and trusting in the future. It is necessary to continually cultivate self-esteem in young people and adolescents so as to avoid despondency when faced with repeated failures. The mathematics class needs to have a healthy atmosphere, where it is possible to discover and not just reproduce knowledge; where all have the possibility to understand all that goes on; where the brighter help the less gifted; where students are assessed together but do not surrender their individuality; where there is joy in intellectual exercise and a delight in learning, rather than discouragement. There is a greater need for stimulation than for criticism. The teacher needs to take account of the learning process. Effort also counts, not just the right answer and attitude not just knowledge, especially if the student is not brilliant in mathematics. In this way much innocent suffering can be avoided.