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Texto 1

Mathematics as a Bridge between Linguistic Descriptions and Perceptual Reality

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Various forms of mathematical symbolism evolved from natural language and, in some instances, visual representations, to fulfill particular functions and, as Joseph (1991) makes clear, historically these developments were not confined to the Western world. However, in the efforts to solve practical problems arising from the political and economic interests of seventeenth- century Europe, modern mathematical symbolism evolved to bridge the gap between perceptual reality and linguistic descriptions. That is, mathematicians such as Descartes (1596-1650) and Fermat (1601-1665) became concerned with investigating curves like ellipses, parabolas, and hyperbolas which described phenomena of the physical world such as the paths of planets, comets, and projectiles. These curves were important for solving immediate practical problems such as those associated with warfare, navigation, and trade. In investigating these curves, the idea was developed that 'to each curve there belongs an equation that uniquely describes the points of that curve and no other points' (Kline 1972: 198). Before this time, it is reported that algebraic symbolic notation was in some state of disarray, fulfilling no obvious purposeful activity. For example, Kline (1972) reports Descartes as explicitly criticizing algebra 'because it was so completely subject to rules and formulas "that there results an art full of confusion and obscurity calculated to embarrass, instead of science fitted to cultivate the mind" (1972: 193). From Descartes's links of the equation to curve, the study of motion and change was independently developed by Newton and Leibniz. This represented a major extension in mathematical activity since 'previous mathematics had been largely restricted to the static issues of counting, measuring and describing shape' (Devlin 1994: 2). That is, the link from text to visual was achieved with the development of Cartesian geometry and calculus where the 'grammatical metaphor' in the form of symbolism was linked to the 'visual metaphor' of the abstract diagrams and graphs.

Galileo's (1564-1642) plan for studying nature through quantitative mathematical description (Kline 1972) had directed Descartes's explorations in mathematics and science. A scientific revolution (Kühn 1970) followed in which quantitative mathematical descriptions of the material world replaced physical explanations of phenomena (Kline 1972, 1980; Wilder 1981). Science was no longer to be based on metaphysical, theological, and mechanical explanations of the causes and reasons for events in the material world. The new goal of science was to seek mathematical formulas to describe phenomena independently of explanations. However, the path to the 'unified' discipline of modern mathematics reveals the discontinuous nature of mathematical knowledge (Foucault 1970, 1972) with shifts in theoretical paradigms (Azzouni 1994; Grabiner 1986; Kline 1980; Tiles 1991; Wilder 1981) and intense rivalry over forms of mathematical notation as documented by Cajori (1927,1952, 1974, 1991).

From a contemporary viewpoint, following Lemke (1998), natural language primarily realizes typographical modalities or categorical descriptions, while mathematics realizes topological modalities or descriptions of continuous variation. Thus the descriptive power of mathematics outstrips the potential of language in the field of continuous covariation and descriptions of relations of parts to a whole. However, although the symbolism allows for complete descriptions of these relations, trends and patterns which are present in these formulations are often difficult to discern. The visual display of symbolic notation in the form of graphs and diagrams allows these trends and patterns to be revealed perceptually (Lemke 1998). However, these visual patterns are only partial descriptions which are further limited in terms of manipulative and calculatory power. As Lemke (1998) explains, the symbolism is thus more powerful but less intuitive than the visual displays.

Modern mathematics evolved as a written semiotic and so may be contextualized with respect to the semantic space occupied by written and spoken language. Halliday makes the point that speech and writing differentially represent reality. ‘Written language represents phenomena as products. Spoken language represents phenomena as processes’ (Halliday 1985: 81). Mathematical symbolic descriptions may be related to the costs involved in which written texts construct a synoptic world of things and their relations while oral texts construct a dynamic world of happenings and processes. Halliday formalizes the cost of written language as ‘some simplifying of the relationship among its parts, and a lesser interest in how it got the way it is, or in where it may be going next’ (Halliday 1985: 97). On the other hand, the cost of the dynamic view is ‘less awareness of how things actually are, at a real or imaginary point of time; and a lessened sense of how they stay that way’ (Halliday 1985: 97). Mathematical symbolic descriptions are concerned with dimensions of meaning which occur in the disjunction between these forms of language. That is, mathematics is concerned with capturing continuous patterns of variation and relations of parts to the whole which reveal the status quo at all points of time. Mathematics captures exact dynamic descriptions of relations as things frozen in time through the lexicogrammar of mathematical symbolism.

Extraído de: O’Halloran, K. Towards a systemic functional analysis of multisemiotic mathematics texts. Semiotica. 124-1/2, p. 1-29, 1999.

Texto 2

The Social Roots of Science*

Zilsel, E.

Galileo's relations to technology, to military engineering, and the artist-engineers are often underrated. When he studied medicine at the University of Pisa, mathematics was not taught there at all. He learned mathematics privately from Ostilie Ricci who was a teacher of the *Accademia del Disegno*, a school for artists and artist-engineers. As a young professor of mathematics and astronomy at the University of Padua, he lectured privately on mechanics and engineering and established working-rooms in his private house where craftsmen were his assistants – the very first university-laboratory. He started his researches with studies on pumps, on the regulation of rivers, and on the construction of fortresses. His first printed publication describes a new measuring tool for military purposes. His detection of the law of falling bodies is intimately connected with the needs of gunnery. The shape of the curve of projection had often been discussed by the gunners of his time. Galileo was the first one who was able to solve this problem. From 1610 onwards he wrote only in Italian, no longer in Latin. This also shows his relations to the lower ranks of society, his aversion to university-scholars and humanists.

Extraído de: Zilsel, E. The Social Roots of Science. In D. Raven et al (eds). The social origins of Modern Science, 2003, p. 3-6. Kluwer Academic Publishers.

Responda às questões 1 e 2 a seguir, com base no texto 1 dado.

Questão 1. De acordo com o texto, houve um período no desenvolvimento da matemática em que a utilização da notação simbólica algébrica, desordenada, não cumpria uma atividade intencional clara. Apresente os comentários da autora a este respeito, e os aspectos históricos citados que contribuem para que esta situação se modifique.

Questão 2. Descreva as distinções trazidas no texto referente aos papéis das linguagens natural, simbólica e visual

Responda à questão 3 a seguir, com base no texto 2 dado.

Questão 3. Elabore uma versão em português do texto.