The Role of the Systemic Approach in the Humanistic Renaissance in Mathematics Education

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Abstract: By humanistic renaissance in mathematics education, we mean its revival in terms of serving man, with a high consideration of human needs, problems and aspirations, and recent developments in both human life and thought. The paper is an attempt to clarify the role of the systemic approach in such a revival through studying the concept of the systemic approach, its role in establishing the methodology of contemporary science, its implications on education and mathematics education, and its contribution to the humanistic revival in the area. Some of the aspects of such a contribution are: Calls for integrating mathematics education with both the study of other disciplines and life, concentrating on problem solving and developing creativity, cohesion of cognitive and psychomotor domains, employing a practical vision in terms of a holistic view of things, uncertainty, nonlinearity … and so on.

The Systemic Approach and Developing Science

One of the greatest achievements in science in the twentieth century is the establishment of the General System Theory (GST)[1]. It is obvious that GST has put the basis for the unity of knowledge, the unity of methodology dealing with it and for the highlighting of the holistic view. Allen sums up the description of GST by saying (1: 28 and 29):

"As a summary statement one can say that GST is a search for universals that can relate the specifics of different disciplines. This has resulted in a formal attempt to integrate similarities among the sciences, to increase communication among scientists, and to develop a theoretical base for axiomatic statements across all disciplines. GST attempts to counter the reductionistic approach of classical science with concepts of interaction, interdependence, communication, and organization… Clearly what is needed is a holistic and flexible approach to problem solving, adaptable to different systems, at different levels, times, and environments. It is my conclusion that GST is such an approach."[2]

GST, or the systemic approach, has been supported greatly by the appearance and development of some theories, specially the information theory and cybernetics[3]. A new advancement is the appearance of theories dealing with behaviour of systems, eg the chaos theory and catastrophe theory. Almost all the mentioned theories are also; interdisciplinary, holistic and characterized, as well as many other features, by uncertainty and non-linearity. Keeping in mind that logical proof was shaken by uncertainty in complex formalized systems as a consequence of Gödel's major theorem of undecidability[4], we many conclude that all these developments, at the heart of which is the systemic approach, have composed and resulted in the new methodology of science and scientific research (ie complexity).

Implications of the Systemic Approach on Education and Mathematic Education

The immediate implication of the systemic approach on education is to consider an educational system as a sub-system of some other supra-systems, such as the societal, regional and human systems, with its own sub-systems, eg aims, structure, administration, finance, curriculum, teacher education … etc, going beyond the linear, even the interaction, models of representation. So, planning and developing education have not been seen as merely "technical" processes, a matter which has been reflected in educational practice and research.

Side-by-side with the "explosion of knowledge", there have been some global changes and developments in psychology[5] as well as the developments of the methodology of scientific research, which have resulted in a new vision of education as being a continuous concurrent education, helping man and serving his / her needs while paying great attention to developing criticism, problem solving and creativity in general.

Mathematics and mathematics education have not been far away of such developments. The new paradigm shifts in both mathematics and mathematics education provide a clear evidence. The paradigm shift in mathematics is from seeing mathematics as the study of formal systems to seeing mathematics as a living body (6 and 7:611) and its reflections on school mathematics programmes[6] (8 and 9). As a result, there are many projects to develop mathematics education on the bases of mathematical modelling, integration and connecting the study with life[7]. Nevertheless, there is still a long way to go before putting these shifts into the practice of teaching mathematics.

Conclusions

Humanistic renaissance in mathematics education can be seen as its revival in terms of serving man (See: 2: 302-303 and 538), which implies giving high consideration to human needs, problems and aspirations, and recent developments in human life and thought. To study the role of the systemic approach in such a renaissance, we may conclude that it has two manifolds; the first is a great contribution to the unity -and transdisciplinarity- of knowledge, science, and methodological changes; the second is that it warns us that to bridge the gap between theory and practice there must be a long way of struggle in order to pave the way to the theory to be accepted and practiced in a particular society, in a particular region throughout the whole world.

To start with, we must recognize, accept and believe in the givens of the systemic approach and its implications on science, mathematics and mathematics education, as a renaissance in these areas, then to start dealing with mathematics and mathematics education on a new basis.

Notes

(1) GST is an attempt to postulate isomorphisms among fundamentally different phenomena (1: 18). A System is defined as a set of elements that are interdependent … Interdependent means that the elements of the system interact, and, more important, whatever affects one element will in some way affect the other elements (1: 22).

(2) So, the writer uses "Systemic Approach" as an equivalent to GST.

(3) Allen pointed out (1: 16) that: "Certainly GST received invaluable contribution from C.E. Shannon in information theory, Norbert Winer in cybernetics, and Ross Ashly also in cybernetics."By cybernetics, we mean the area of science which is concerned with the study of the common general characteristics of different control systems, which are not associated with their materialistic basis, therefore they appear in physical reality, organic world, groups of people … etc. Some of the sequences resulted in new developments in computer technology, self-regulated machines … and others.

(4) Note that this was supported by Popper's replacement of "falseiability" instead of "verification" of scientific theories (See: 3 and 4).

(5) Specially, cognitive psychology and the appearance of the multiple intelligences theory.

(6) This shift has been reflected in primary school mathematics programmes "from seeing mathematics as a large collection of concepts and skills to be mastered in some strict partial order to seeing mathematics as something people do (8: 3655), and in secondary school mathematics programmes from the "formal" teaching of mathematics to introducing mathematics as a human activity in order to provide a basic preparation of learners for full participation as functional members of society (9: 3661). Note that there was an attempt to "theorize" the paradigm shifts in mathematics and mathematics education (See: 5).

(7) Examples of these projects are: Applicable Mathematics, Mathematics in Society (MISP) and Integrated Mathematics, Science and Technology (IMaST).

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