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Some Remarks On The Future of Mathematics Education

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Abstract: *The aim of this paper is to attempt putting discussions on the future of mathematics education into perspective. The suggested remarks could be seen as limitations when dealing with such a topic.*
The most important of these remarks are related to: The position of mathematics curricula as a sub-system of many wider systems; the effect of globalization on the future of mathematics education; and different probable scenarios for the future of mathematics education, e.g. "progressive", "reformatory" and "conservative" ones.
However, we can speak about the future of mathematics education in many different terms, ie short, medium and long terms. Some expectations in short and medium terms, ie growing trends, could be related to the use of technology in teaching the subject, and introducing some changes in methods of teaching and evaluation. Long term expectations, extending to the year 2020 or after, are related to the aims of education, concentrating on developing creativity, integration, applying the methodology of "complexity", rejecting the formal teaching of the subject, putting "multiple intelligences" into practice and changing the whole educational environment.

Introduction

It is natural to "dream" in the context of future studies, the dreams almost always being "sweet" dreams, a matter which is also, applicable to studies concerning the future of mathematics education. Nevertheless, there are some pessimistic views in this concern. Therefore, there is a need to put discussions on the future of mathematics education into perspective, this being one of the aims of the present paper.

To start with, we assume the following :

1- There is no one direction or way to develop mathematics education at the world level nor at the societal level. Actually, there are some alternatives at both levels.
2- There could be growing trends, generally accepted at both the international and local levels. However, they may be adopted in some, not all, societies. Further, there are different ways and limitations for applying trends in different countries.
3- Education at large, and consequently mathematics education, is affected by the process of "globalization" (1) in some different terms and extents. Nevertheless, such an effect may differ among schools in the some country.

Hoping to raise more discussions about the future of mathematics education, the present paper includes the following sections:

a) The future of mathematics education from the systemic perspective.
b) The effect of globalization on mathematics education.
c) Growing trends in mathematics education.
d) Extreme continuals of major components of future mathematics curricula.

The Future of Mathematics Education from the Systemic Perspective

The writer wrote in 2002 that(2):

"One of the greatest achievements in science in the twentieth century is the establishment of the General System Theory (GST). 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 wholistic view … The immediate implication of the systemic approach in 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 training … etc, going beyond the linear, even the interaction, models of representation."

Therefore, any attempt to deal with the future of mathematics education should deal with many different systems before reaching mathematics curricula. Therefore, there is no place for the "technical" view in developing mathematics education. Examples of these systems are : The globalization process, emerging changes in contemporary science, emerging trends of change in psychology and education, paradigm shifts in both mathematics and mathematics programmes (3) (as related to the "human culture"), emerging

trends of change in regional culture, future changes in the sub-systems of the social and educational systems in the country under study.

Nevertheless, there could be alternative future scenarios at the world level, with each country differing in its position towards them, whether as a whole or in detail, according to its unique case. Suggested prospective scenarios for mathematics education around the year 2020 are: conservative, reformatory and progressive scenarios(4).

The Effect of Globalization on Mathematics Education

As referred to above, the process of globalization affects education, and therefore mathematics education. Such an effect has some advantages and some disadvantages. At the core of the advantages are: calls for developing creativity (at least, in order to get a job) and for self concurrent education, and the availability of open education at all levels through the use of almost always advanced technologies in many societies. On the other hand, some disadvantages of globalization on education are: The prevailing call for the privatization of education which represents one of the requirements for a society to get a share of "globalization" whatever it is (at least investing capitals in the country by transnational corporations). These requirements include acquiring some values and ways of behaviour, which are associated with the process of globalization, which might not suite some (good) traditions in some countries. As a result of globalization there exists the process of "polarization"(5). Such a process refers to the classification of people of a society into two major groups; one generally enjoying good education, particularly the use of advanced technology in education and almost mastering foreign languages (especially English), where the other group, usually the poor or some middle class people, have poor education and no, or little, access to advanced technology. Such a classification is applicable at the world level, with some people having good communication, almost with some common interests and to some extent common education, while the others do not. This is actually the process of polarization in its global level.

Educators, including mathematics educators, must be aware of the advantages and disadvantages of globalization, supporting developing creativity and continuous self concurrent education, and struggling, at the meantime, against its disadvantages, especially, the process of polarization.

Growing trends in mathematics education

By growing trends in mathematics education the writer means those emerging trends in mathematics curricula, whether those which are going to be applied widely or in an experimental form; or present calls in the context of developing mathematics education which find acceptance among many mathematics teachers and educators (6). The most important of these growing trends could be summed up as follows (7):

1- The aims of mathematics education are : to develop creativity, making the study enjoyable and applicable in life, and to prepare students to deal with future changes in all respects, mainly through self-education.
2- Using both manual operations and calculators in computing in primary education, with more supporters of the use of calculators in computation at this level of study.
3- Mathematics is still to be taught as a separate syllabus, but greater attention is given to the applications of mathematics in life and other disciplines, and to mathematics modelling.
4- Attention is increasingly being given to stating assumptions behind different formulas (particularly when adopting the linear model), the existence of different possible alternative solutions to many problems and realizing "common features" among different systems.

5- Dealing with some levels of "curricula", may be by means of using different materials and/or text-books.
6- A gradual decrease of the use of the traditional formal teaching of mathematics.
7- Using technology, to some extent, in the learning/teaching processes, with growing emphasis on collecting data and self-learning.
8- A great deal of interest is given to continuous and non-formal evaluation, but there will remain an important status of final written examinations, mostly by the end of educational stages, to include different cognitive levels.
9- Introducing major changes in mathematics teacher education, whether pre- or in–service education. There will be growing trends in pre-service education towards "professionalization" (8), and in in-service education to support the growing trends in mathematics education including the use of non-traditional methods and means in such an education, eg self-education, dialogue, brain-storming, assignments, advanced technology … etc.
10- A great role is given or has significantly been increased to mathematics teacher organizations – in their different forms – in changing and controlling school curricula.

Extreme Continuals of Major Components of Future Mathematics Education

As assumed above, there is no single way or direction to develop mathematics education. Therefore, the picture of mathematics education around the year 2020 will differ, may be to a great extent, among different countries. This section is devoted to present the writer's view concerning the extreme continuals of the major components of future mathematics education. The most important of these continuals are as follows (9):

1- The aims of education:
a) Developing creativity, making the study enjoyable and preparing students to deal with future trends both in knowledge and careers.
b) Reaching a high level of achievement in different branches of mathematics.

2- Computing:
a) Concentrating on conceptual bases with very little attention to computations, as with the use of calculators and computers.
b) Concentrating on manual operations in the first grades of primary education with the possible use of calculators.

3- Integration:
a) The study will almost be in integrated contexts.
b) Curricula are in the form of separated syllabuses.

4- "Complexity":
a) Emphasis is given to stating assumptions behind different formulas, the existence of different possible alternative solutions and to "commons" among different systems.
b) Formulas are almost always supposed to be correct and certain with marginal deviation, if may, in relation to the points raised in a) above.

5- The taught "curriculum":
a) Multiple curricula, may be provided to individuals or groups, being based on multiple intelligences theory.
b) Fixed curricula and text-books, with different levels of explanations and/or exercises.

6- Formal teaching:
a) No "traditional" formal teaching, while encouraging student's to "theorize" for themselves.
b) Mainly "traditional" formal teaching.

7- Using technology:

a) Intensive use of technology with emphasis on data collecting, building knowledge and self-learning.
b) Using technology in learning/teaching processes is almost restricted to certain syllabuses.

8- Evaluation:

a) Mainly continuous and non-formal evaluation, with great attention to self-evaluation and discussion of student's reports and "research work".
b) A part of evaluation is given to continuous evaluation, but final examinations, especially by the end of educational stages, are highly stressed. Memorizing is unavoidable, though attempts are made to avoid it.

9- Teacher education:

a) Professionalization of programmes of pre- and in-service teacher education, while employing non-traditional methods and means in both programmes.
b) Programmes of pre- and in-service teacher education are designed to "train" teachers to teach mainly the "traditional" curricula of mathematics.

10- Teacher organizations:

a) Teacher organizations will have the first say in curriculum adoption as well as school practices.
b) Teacher organizations will have little to do with mathematics syllabuses and school practices.

A Final Word

It is clear that there are many alternatives to the future of mathematics education in a particular society. For the planning purpose, it is advisable to adopt the most advanced, or progressive, alternatives (referred to above as a's), provided that the societal conditions and the conditions of the educational system in such a country allow the implementation of this alternative (or some of its alternatives).

In this context, a reference should be made to the fact that the extreme continuals suggested above are very approximate and could be extended, and to that developing mathematics education does not mean the disappear once of "polarization", the amount which differs among different countries.

Notes

(1) We adopt the definition of globalization as:
"The obvious increasing interference of economic, social, political, cultural and behavioural matters without taking into consideration the political boarders of countries having sovereignty or belongingness to a particular nation or state and without a need for a governmental action … Where transnational corporations have become the central organizers of economic activities in a world economy which has increasingly become integrative."
Abdalla, Ismail S. (1999). "Characterizing of Contemporary World Situations", **Egypt 2020 Papers**, 3. Cairo: Third World Forum-Middle East Office .. (In Arabic) P. 7, P. 9.

(2) Mina, Fayez M. (2002). "The Role of the Systemic Approach in the Humanistic Renaissance in Mathematics Education". In : Alan Rogerson (Ed.), **Proceedings of the International Conference of the Mathematics Education into the 21st Project on "The Humanistic Renaissance in Mathematics Education",** Palermo, Italy, September 20-25, 2002, P. 267.
Note that a system is defined as a set of elements that are independent, which means that the elements of the system interact, and more importantly, whatever affects one element will in some way affect the other elements … GST is an attempt to postulate isomorphisms among fundamentally different phenomena (systems).
See:
Allen, T. Harrell (1978). **New Methods in Social Science Research; Policy Sciences and Future Research**. New York: Praeger Special Studies. P. 22, P. 18.

(3) See:
Mina, Op cit.
Husén, Torsten and Postlethwaite, T. Neville (Eds.) (1994). **The International Encyclopedia of Education,** Second edition. Oxford: Pergamon Press. PP. 3655-3668.

(4) See:
Mina, Fayez M. (2001). "Prospective Scenarios for Mathematics Education Around the Year 2020". In : Alan Rogerson (Ed.), **Proceedings of the International Conference of Mathematics Education into the 21st Century Project on "New Ideas in Mathematics Education",** Palm Cove, Australia, August 19-24, 2001, pp. 176-179.

(5) See:
Mina, Fayez M. (2000). " Theorizing for Non-theoretical Approaches to Mathematics Education". In: Alan Rogerson (Ed.), **Proceedings of the International Conference of the Mathematics Education into the 21st Century Project on "Mathematics for Living"**, Amman, Jordan, November 18-23, 2000. P.8.

(6) Needless to say, identification of these growing trends is based on the writer's judgement, which can be different from the judgements of others. However, one of the aims of the present paper is to raise discussions about the future of mathematics education. At the core of which are those growing trends.

(7) The writer has used the general framework of components of mathematics curricula of the suggested scenarios.
See:
Mina (2001), Op cit, pp. 178-179.

(8) Professionalization means that teaching and learning in programmes of pre-service teacher education should be conducted in an atmosphere comparable to what ought to be at schools in its ideal form, in relation to analyzing and teaching particular curricula. Also, intensive discussion and analyses of the reality of schools, curricula and teaching, and the role of the teacher in developing them are essential to teacher education in the context of professionalization.
So, particular emphasis will be given to developing creativity, integration, introducing major changes in the teaching and evaluation processes and educational activities, employing "complexity" in dealing with different issues, practicing self-education, using advanced technology in learning and teaching processes … etc.

(9) Note that a) and b) refer to the extremes of the different continuals of some components given the numbers 1, 2, 3 … etc where a) refers to the most progressive scenario b) refers to the most conservative one. Of course, these estimates are in an approximate form and are subject to change.
See: Mina (2001), ibid, pp. 178-179.

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