

Available online at www.sciencedirect.com**SciVerse ScienceDirect**

Procedia - Social and Behavioral Sciences 46 (2012) 2681 – 2685

Procedia
 Social and Behavioral Sciences

WCES 2012

Case studies - The role of them in mathematics teaching

Gratiela Ghic^{a*}^aPhD Associate Professor, Christian University „Dimitrie Cantemir”, International Business and Economics Faculty, Bucharest, Romania

Abstract

Starting from the fact that in recent years I have noticed that my students are reluctant in to accepting Maths, I have tried to find the reasons for this attitude and especially the ways to redress this undesirable situation. Through the years, teachers have struggled to make math meaningful by providing students with problems and examples demonstrating its applications in everyday life. Nowadays technology makes it possible for students to experience the value of math in daily life instead of just reading about it. Case studies drawn from real life give meaning to theoretical concepts. Thus, the student is interested in what can be done using a specific concept.

© 2012 Published by Elsevier Ltd. Selection and/or peer review under responsibility of Prof. Dr. Hüseyin Uzunboylu

Open access under [CC BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/).*Keywords: mathematical modelling, mathematics teaching and learning, classroom experiences; maths – phobia.*

1. Introduction

“Don’t forget the man while reading the theorems and equations”

Albert Einstein.

Starting from the fact that lately I have noticed that the students simply refuse to accept Maths, I have tried to find the reasons for this attitude and especially the ways to correct this undesirable situation.

I made a survey with a very tough title: “I’m sick of Maths – a post-December phobia”, trying to look thoroughly into the clash that made the pupils and students to pass on the other side of the mathematical strictness. It was extremely hard for me to make them speak honestly. Of all the 300 essays I picked a fragment: “ I belong to the generation having sacrificed for the welfare, I’m a child looked after by grandparents, nannies, boarding schools teachers, I’m a harmful investment...my parents fed me up with private classes and numberless teachers, trying to replace their absence. They wished I had been up to their expectation and endeavours but they failed to know I had my own limits, my traumas, my desires...However, I miss mother reading the a Maths problem in my first school year...” Maybe this is the most touching and upsetting truth I have found. Maths has a very important role in shaping a teen’s personality. Its instrumental importance relies on the logical and rigorous thinking development and on its applications in different fields. The last decade brought about an important ignorance regarding the Romanian schools problems, especially mathematics, and they have become more and more serious, getting even critical. Mathematics is generally defined as the science that studies the quantitative relations, the patterns of structure, change and space. In a modern interpretation, Mathematics represents the investigation of the abstract structures

* Gratiela Ghic. Tel.: +040723243537

E-mail address: grati.ela@alternativeit.ro

axiomatically defined by means of formal logic. That is quite a scaring definition and makes us trust the above mentioned title. Anyway, we should be patient such as Luc de Clapiers de Vauvenargues (Introduction to knowledge of the human spirit, followed by reflections and maxims, 1746): “Patience is the art of being hopeful”, so let’s not lose our hope as certainly Maths still has a chance.

The word *maths* comes from the Greek *máthema*, meaning “learning”, “study”, “science”, in its turn coming from the verb *manthanein*, “to learn”. The term *mathema* got the accurate meaning “mathematical study” ever since the classical period. The corresponding adjective is *Mathematikós*, meaning “related to learning” or “industrious”, later on, “mathematical”. The terms were borrowed by Latin from Greek and the mathematical sciences, in Greek *mathematik. Tékhne*, were called “ars mathematica”.

“I’m Maths sick” is a bad mood characteristic to some pupils who come to school just for fun or caused by the knowledge fading out in college.

However the real reason for “I’m sick of Maths” is deeply rooted in “I’m sick of *máthema*” or “I’m usually sick of learning” The „*mathematikós*” pupil will never have these symptoms as in order to study Maths a hard work is necessary, the knowledge is acquired in time, step by step, time and again, every new knowledge deriving from the previous one, connected by many exercises.

The fear of Maths is a natural consequence of our society evolution, where the motto is superficiality and the material: we would like to obtain the more, the faster with the less effort as we want the results in no time. On the other hand, the study of Mathematics needs dedication, it has no immediate and spectacular results, a constant, intense and frustrating effort is necessary most of the times. In fact, at the psychological level, one of the explanations could be the following: mathematics means frustration, the frustration of making useless efforts, of not understanding, of being unable to exceed your limits, of considering yourself defeated.

“I’m sick of Maths” occurs where some factors have a negative influence. There was neither support from parents, society or teachers nor enough information and guidance to stimulate the pupil’s desire and interest.

The surveys showed that the poor results in Maths are caused by character deficiencies, lack of motivation, pupil-teacher conflictual relations, the poor family conditions, the low interest in getting good results, the negative self-assessment, classmates’ and parents’ disapproval, lack of intellectual abilities etc. The good results a pupil gets in Maths do not emphasize his “sheer” skills for this field but the educational efficiency of this ability, controlled by interest, motivation, endeavour and emotional stability, by the way he perceives Maths and especially good connections among them.

2. Interdisciplinarity and transdisciplinarity of Mathematics

Trying to find a way to communicate I discovered the cause of the clash between pupils and Maths. Every time I tried to make them like Maths I hopelessly failed. I do not mention the pupils who learned because they had to but those who wondered why they should learn it. Maths is too difficult, most of the times meaningless...or ...too abstract and practically useless...or maybe the specialists live in a world of concepts, in an ideal world...or they want to become economists, lawyers, doctors, linguists, biologists...therefore pupils can’t make out the use of Maths for such a career.

Besides the first lessons of Mathematics applied in Economics, I suggested the students to approach the following topics: “Interdisciplinarity and transdisciplinarity of Maths” with the chapters: Maths and movie, Maths and poetry and Maths and sports.

The written essays were amazing. Some of them surprisingly discovered another aspect of Mihai Eminescu (1850-1889) in the poem “To the Star” taking into account the speed of light (299 792 458 m/s), of Ion Creanga (1821-1889) in “Five breads” or the anticipation of Nash’s equilibrium, of Nichita Stanescu (1933-1983) and his hide-and-seek with Mathematics, of Ion Barbu (1895-1961), a Maths teacher (Dan Barbilian).

They were surprised while reading The Mathematic Poetry by PhD. Professor Solomon Marcus and they learned they were contemporary with a great mathematician, concerned with the interdisciplinarity of Mathematics (Solomon, 1970). Hence I won over the students who stated they were humanists.

They have discovered that a Maths professor can find a way to make students/pupils interested in this subject or at least willing to accept it to a certain extent. First of all, a Maths professor should help students/pupils grasp beyond these symbols and make them understand the use of acquiring these concepts. He should prove his mastership in providing connections between the abstract concepts and the real phenomena or other notions from different fields.

An interdisciplinary approach of Maths terms may offer the opportunity of Maths revival. Today we do not make a difference among disciplines. Nowadays the world image does not encompass shares such as: Maths, Physics, Economics etc. Actually the sciences share the same reality. The current knowledge is inter/transdisciplinary.

In the mathematics activity, conceiving non-algorithmic processes is very important for the pupils to be able to solve even the problems with no algorithm. We need a creative behavior or at least a conscious one, where the mathematical modeling should be less and less important as people must understand the things done the best way they can.

The Mathematic activity must be complex, meaning a comprehensive, useful activity not a complicated one. As for these problems, the external result has no relevance as seeking it and its educational effects are valuable.

Nowadays, almost all the interdisciplinary scientific approaches involve the mathematic knowledge. Yet, Maths is a formal system: it is about its strength and weakness. In the Anglo-Saxon terminology, it is obvious that Maths does not belong to Natural Sciences. A mathematician pays careful attention to every detail without saying things he doesn't know or can't do. Pupils and students should get used to checking the hypotheses. However if somebody uses a theorem/rule beyond the hypotheses where it is valid, this has no connection with Maths. There is a common irrational tendency to use a Taylor row besides the convergence interval... with spectacular results.

3. “What is the purpose of a Maths book?”

While the first topic was about the students' worries, the second aimed at making them find the answers favorable for a connection between them and Maths. Only then, when I finally found it proper, I asked them: “What is the purpose of a Maths book?”

“The Maths teacher, focused on the strictness of the books contents, fascinated by the beauty and clarity of demonstrations, forgot to sing, to recite or paint...He turned into a little black and white man, enjoying his solitude, hanging up above the dreams and thoughts of his few fatigued pupils watching him...”

“...A Maths book does not aim at making us problems as we used to think when we were first class pupils, it teaches us how to solve ours. It has educated us since childhood and it still does. It helps us perceive everything around us not like a bunch of problems and questions but like a mere opportunity to find new more and more diversified and sophisticated solution, continuously developing and adjusting to the new life styles, jobs and responsibilities.

“The science of Maths has no connection with our soul so that it could be cherished. History, panning and reviving the past, literature, imagining and beautifying expressions, geology, chemistry, biology with their practical and national problems do not need to prove they are useful. Here their representatives describe the riches of the country from a personal point of view: thoughts, feelings and energy. Maths neither solely possess nor can it have a national significance” as stipulated in Gheorghe Țițeica's reception speech at the Romanian Academy, on May 29th 1914.

Times and again reading this paragraph in professor Solomon Marcus' speech – “The solitude of Maths”, I remembered the wonderful clue of lecture (Mathematical Analysis) in 1st year: pathway to history of Maths.

Summarizing the ideas of more than 100 essays with this title, I could reach the following conclusion: a concept with no story keeps the students away. Certainly, Maths has a history and this is not straight at all. Maths got through crises, following a track with ups and downs, with detours and drawbacks. Moreover, Maths was not alone and changed its shape. At the same time Maths was and it still is philosophical speculation, empirical science, formal - logic subject. These different aspects influenced, shaped and enriched it in the past. Thus, we can say that the history of Maths is the history of philosophy as well as the history of physics. Moreover, the history of mathematics is the history of culture due to its creators since the great mathematicians belong to the most important

ideological trends and the famous mathematic theories have certain tracks in culture. Although a printed course is poor in such presentations, the lecture may start from a short history of the specific concept.

On the other hand, the necessary mathematic demonstrations should not flood in the book. The students need examples and counter-examples to make the notions clear.

4. The importance of case studies in teaching mathematics

The case studies emphasize the theory, shaping it, especially in Mathematics applied in Economics. Here there are some examples:

- I suggested my students to find topics of discussion for each lecture. As for the matrix calculation they suggested “The states transition matrix” for a case study. Although the stated didactical purpose is the layout of Gauss Method for solving the linear equations systems, the above case study manages to make the method easily acquired both by the students gifted in Maths and by the humanists.

In the same chapter, I insisted on passing from the economic language into a mathematic one. Although two matrixes may have dimensions suitable for mathematical addition, this does not provide the significance of their addition. For example, a 3x2 matrix describing the number of the employees in three companies, gender classified, added to a 3x2 matrix describing the number of sales agents’ cars for three companies, classified by the cars type, would have a meaningless result (Francis, 1995).

- While for the linear programming problems the practical character is obvious we cannot say the same about the notions of mathematic analysis. There is a slight resemblance to economics only from the microeconomics studies point of view. Taking into account the above introduction, the case studies related to the optimization problems were chosen as follows: the setting up of the consumer’s and producer’s best decision. During the debates the students discovered the work of a Romanian famous economist and mathematician Nicholas Georgescu Roegen (1906-1994).

- The students have known the probabilities applications in the real world ever since high-school. In the optional bibliography there are two interesting books: *The unfinished game*. Pascal, Fermat and the 18th century letter which created Keith Devlin’s modern world and *God is mathematician* by Mario Livio. The debates on these works were quite intense and we always changed the roles... the pupil became a teacher and vice-versa (Livio, 2010; Devlin, 2010).

5. Conclusions

Actually the Mathematics study is essential for the technological progress, economic development and certainly for the mankind evolution. However, the complexity and the opaqueness of this subject for the ordinary man’s point of view, with a medium IQ, causes rejection and even phobia. Maths-Phobia is not a post December phobia and a Romanian one either. As I mentioned before, the main reason of this fact is the abstract character of this subject, the common man’s difficulty to “visualize” the presented notions and their connections with the daily problems.

This three years survey on about 500 students proved that first of all it was necessary for the professor to know the student, to approach teaching in a reflexive way, in order to be further adjusted to the educational-instructive process.

The role of modeling in teaching Maths does not limit the analysis only concerning the case studies. To find the connections between Maths and arts and Maths and sports represents a purpose itself.

The Maths interdisciplinary power involves not only the elaborated general concepts and instruments but also the way of thinking it develops, such as: the analogical, cumulative, algorithmic and probabilistic thinking. Looking back to our society, we can say we need people who think in an interdisciplinary way, able to easily pass from a subject to another and school must instruct them in this respect. An interdisciplinary tuition may be helpful for the pupils to largely perceive the world, to acquire the basic values and easily distinguish the goals and the means.

Finally, Maths might be said to enrich the other subjects with its virtues: wisdom, freedom and gratiouteness.

References

- Devlin., K. (2010). *The Unfinished Game: Pascal, Fermat, and the Seventeenth-Century Letter that Made the World Modern*. Ed. Humanitas, Bucharest.
- Francis, A. (1995). *Business Mathematics and Statistics*, 4th edition, DP Publication Ltd.
- Livio, M. (2010). *Is God a Mathematician?*, Ed. Humanitas, Bucharest.
- Marcus, S. (1970). *Poetica matematica*, Ed. Academiei, Bucharest.