

Benefits from Integrating History of Mathematics into Teaching

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Abstract.*In this paper we underline some of the reasons doing the integration of history of mathematics into teaching as well as in learning so much beneficial. We cite many excellent authors and experts on the subject using their bright ideas to argue the importance of including the history of mathematics in the school because "...the history of science is science itself" (Johann Wolfgang von Goethe, Theory of Colour (1808)).*

It's great to be a mathematician because "...the mathematics is the queen of all sciences". But its evolution wasn't an easy process. The road it followed was very difficult, through great storms and struggles to arrive at this grand temple we have today. The history of mathematics is written from simple people to great researchers, inventors and philosophers with their bright thoughts sculpted eternally on its temple. For many many times till now the problem of integrating the history of mathematics into teaching and learning occupied the mind of mathematicians, scholars, scientists etc. The interest for integrating the history of mathematics in these directions we mentioned above, is grown very much in the last years. The importance of HOM (History Of Mathematics) in the scholar curriculum is pointed out more from the presence of many professional councils such as the National Council of Teachers of Mathematics (NCTM), National Research Council (NRC) and National Council for Accreditation of Teacher Education (NCATE). In the National Council of Teachers of Mathematics (NCTM, 2000), is pointed out:

"Mathematics is one of the greatest cultural and intellectual achievements of humankind, and citizens should develop an appreciation and understanding of that achievement, including its aesthetic and even recreational aspects". (p.4)

Swetz is one of the greatest authors and distinguished experts in the field of the history of mathematics. Among others, he writes:

“The history of mathematics supplies human roots to the subject. It associates mathematics with people and their needs. It humanizes the object and, in doing so, removes some of its mystique. Mathematics isn’t something magic and forbiddingly alien: rather it’s a body of knowledge developed by people over a 10.000 year period. These people, just like us and our students made mistakes and were often puzzled, but they persisted and worked out solutions for their problems. Mathematics is and was people centered. Its teaching should recognize and build on this fact by incorporating the history of mathematics as a fundamental part of its learning”. (Swetz, 1994).

J.W.L. Glaishier (1848-1928) has written for the subject too:

“I am sure that no subject has more losses more than mathematics by an attempt to dissociate it from its history”.

The history of mathematics makes up an important component for learning of mathematics. Its integration into mathematics curricula helps the students to understand that the mathematics is

“...a discipline that has undergone an evolution and not something that has arisen out of thin air.” (Jankvist, 2009, p. 239)

Or referring again to Swetz:

“Learning is both cognitive and affective. So, too, are the mathematics problems of history”. (Swetz, 1989, p. 376).

So, for example, the numbers, in particular, and the development of numeric systems, in general, have drawn back the attention of the mathematicians and other people everywhere in the world for thousands of years. Our ancestors used primitive ways for numbering. As an aphorism says: “Upon a people’s limited language, nonverbal mathematics was the first mathematics”. The first arithmetic notations are met since the ancient Egypt, in Babylonia, China and India. In the theories of the sixth century BC, Pythagorians teach us that everything in essence is a number and all relationships can be expressed numerically. In the nineteenth century Europeans

formulated mathematical definitions of certain kinds of numbers as equivalence classes or correspondences. Richard Dedekind, who formally created the complete set of real numbers wrote:

“Of all aids which the human mind has yet created to simplify his life, that is, to simplify the work in which thinking consists—none is so momentous and so inseparably bound up with the mind’s most inward nature as the concept of number. Arithmetic, whose sole object is this concept, is already a science of immeasurable breadth, and there can be no doubt that there are absolutely no limits to its further development, and the domain of its application is equally immeasurable, for every thinking person, even he does not clearly realize it, is a person of numbers, an arithmetician”.

Today the knowledge of numbers has helped us in commerce, in our communication worldwide as well. Hence, the study of this piece of mathematics, of these titanic and century-old endeavours, must get an important place in school and in our everyday life. Next, Cajori, in his introduction of the book “A history of mathematics” writes:

“The history of mathematics may be instructive as well as agreeable; it may not only remind us of what we have, but also teach us how to increase our store”.

Citing De Morgan, he continues:

“The early history of the mind of men with regard to mathematics leads us to point out our own errors; and in this respect it is well to pay attention to the history of mathematics”.

Hence, the students will understand in this way that they have to concern with a human activity, invented, changed and extended under the influence of people for many and many times. Instead of seeing mathematics as a ready made product, they, on the contrary, will understand that mathematics is a science that changes continuously and so this will help them to extend the knowledges in which they can contribute themselves. Moreover, the history underlines the relationships between the mathematical questions and the role of mathematics in other disciplines, which will help to put mathematics itself in a wider perspective and to help the students, too, to deepen their understanding. The history of mathematics enables them, also, to obtain a clearer image for what mathematics itself is. The teachers themselves can see, can feel

that the information in the development of a mathematical question can help them to simplify the explaining or the giving of an example. The history of mathematics is a powerful mean in the hands of the teachers and researchers because it gives to them a great numbers of interesting mathematical problems which may be used in a explicit or implicit way. It can bring new perspectives in the analysis of the students's work. Another great author, Fried, writes:

“First of all, while the history of mathematics can bracket the present in order to understand the past, mathematics education typically justifies itself by the power and necessity of mathematics in modern contexts, engineering, economics and industry”.

Then, he cites the American Principles and Standards for School Mathematics (NCTM, 2000) in which is written:

“The level of mathematical thinking and problem solving needed in the workplace has increased dramatically. In such a world, those who understand and can do mathematics will have opportunities that others do not. Mathematical competence opens doors to productive futures. A lack of mathematical competence closes those doors”.

Wilson & Chauvot (2000, p. 642) present this important benefit of using the history of mathematics into the classroom. According to them, its inclusion,

“...sharpens problem solving skills, lays a foundation for better understanding, helps students make mathematical connections, and highlights the interaction between mathematics and society”.

Next, Bidwell (1993) brings out the ability of the history to do mathematics a human discipline. Including the history of mathematics, he writes that

“...we can rescue students from the island of mathematics and relocate them on the mainland of life that contains mathematics that is open, alive, full of emotion, and always interesting” (p. 461)

The integration of the history of mathematics into teaching is beneficial for students as well as for teachers. For example, it constitutes an efficient mean to motivate the students to learn. The history of mathematics has many events charged with emotions. Their integration into teaching can draw the attention and stimulate the curiosity, the creativity and interest of students for the

mathematics itself. The integration of the history of mathematics into school mathematics can improve the students and teachers perception for the subject. This integration into teaching can help teachers to answer many questions that may arise into the classroom. These questions may have different origin. For example, the students might have questions about the computational methods, notations, terms and words that are used into mathematics. (see Bidwell, 1993, Kelley, 2000). In fact, mathematical terms can be viewed, as Rubinstein & Schwartz write:

“...as preserved fossils from old time, and digging them up can result in a fascinating discovery of how mathematics evolved”. (p. 664).

So, by means of the study of the history of mathematics and its available integration into teaching, the teachers of mathematics are rendering more sensitive and they understand better the difficulties that the students can meet in understanding of some mathematical concepts and terms. Through the integration of the history of mathematics into teaching the students themselves don't feel alone in their efforts for solving many problems which make them more audacious. The study of the historic development of mathematics enables the teachers as well as students to understand the evolutionist character of this science. So, the recent mathematical theories, the ideas and the procedures may be seen as Davitt (2000) writes:

“...as polished diamonds that started off as rough pieces of carbon”. (p. 692)

Indeed, the history of mathematics is a living science that:

“...creates a bridge from the past to the future”. (Reimer & Reimer, 1995, p. 107)

and it shows:

“...how the conjunction of the old and the new is a commonly occurring event in the development of mathematics today”. (Grugnetti & Rogers, 2000, p. 55)

The teaching of the history of mathematics allows students to understand the cultural, political, social and economical contexts of mathematics. Its integration in school opens the doors of a multicultural model of teaching. This multiculturalism may be seen as:

“...the identification and celebration of diversity,the respecting and valuing of the work of others,the recognition of different contexts,needs,and purposes,and the realization that each society makes and has made important contributions to the body of knowledge we call mathematics.”(Grugnetti&Rogers,2000,p.51)

The integration of the history of mathematics into scholar mathematics makes up an excellent mean for the acknowledgment of so much relationships which exist between different fields of mathematics and between the mathematics itself and other disciplines.The Curriculum and Evaluation Standards for School Mathematics(NCTM,1989) stated that:

“ Students should have numerous and varied experiences related to the cultural,historical,and scientific evolution of mathematics.”(p.6)

And next ,here again,is pointed out that the main intention of learning of mathematics is:

“ ...to focus attention the need for student awareness of the interaction between mathematics and the historical situations from which it has developed and the impact that interaction has on our cultures and lives.”(p.6).

Similar recomandations which are concerned with the role of the history of mathematics are found in NCTM’s Principles and Standards for School Mathematics(2000),with main objective that of developing by the students to a right evaluation of mathematics as:

“...being one of the greatest cultural and intellectual achievement of humankind.”

And,again there it’s stated:

“Students develop a much richer understanding of mathematics and its applications when they can view the same phenomena from multiple perspective.”(p.289)

In their work,Gulikers and Blom give arguments with which one can answer the question why the history of mathematics may be so beneficial if included into teaching and learning.Their arguments are:

- Students derive comfort from realizing that they are not only ones with problems so that they get less discouraged by misunderstandings and mistakes.

- History of mathematics helps students to learn in a non-linear way. The development of mathematical ideas proceeded not as smoothly as modern text books mostly suggest.
- History of mathematics helps students to acquire a balance between ‘rigor’ and ‘imagination’.
- Since history of mathematics can help develop a multicultural approach in the classroom, it may help teachers work with multi-ethnic classes and can help develop tolerance and respect among fellow students.
- The use of history of mathematics provides opportunities for cross-curricular work between mathematics and other disciplines.
- The history of mathematics helps to explain the role of mathematics in society, shows the development of mathematics as a human activity, helps to create a lively classroom atmosphere, and helps to increase students’s interest for learning. (p.227-230)

Liu(2003) added to the list of Fauvel(1991) with fifteen such reasons for integrating of this history of mathematics into mathematics curriculum, other five:

- History can help increase motivation and helps develop a positive attitude toward learning.
- Past obstacles in the development of mathematics can help explain what today’s students find difficult.
- Historical problems can help develop students’ mathematical thinking.
- History reveals the humanistic facets of mathematical knowledge.
- History gives teacher a guide for teaching. (p.416)

Returning again to Cajori we read:

“The history of mathematics is important also as a valuable contribution to the history of civilization. Human progress is closely identified with scientific thought. Mathematical and physical researches are a reliable record of intellectual progress. The history of mathematics is one of the large windows through which the philosophic eye looks into past ages and traces the line of intellectual development.”

And finally, as Niels Henrik Abel(1802-1829) remarked in his notebooks:

“It appears to me that if one wants to make progress in mathematics one should study the masters.”

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