THE IMPACT OF USING MATHEMATICS PROBLEMS WITH HISTORICAL BACKGROUNDS IN THE TEACHING OF MATHEMATICS ON STUDENTS ATTITUDES TO THE SUBJECT.

Greisy Winicki
Department of Education in
Technology and Science - TECHNION
Israel

Curiosity and the urge to solve problems are the emotional hallmarks of our species (HOMO SAPIENS); and the most characteristically human activities are mathematics, science, technology, music, and the arts - a somewhat broader range of subjects that is usually included under the 'humanities'. Indeed, in it is common usage this very words seems to reflect a peculiar narrowness of vision about what is human. Mathematics is as much a 'humanity' as Poetry.

Carl Sagan - The Dragons of Eden

Mathematics is generally taught in school without any historical background: most of the pupils having no idea of the historical context of mathematics development. This is true for almost all stages in education, in elementary school, junior and senior high school, and to some extent in university too. Most pupils consider mathematics only as a collection of facts to be remembered by heart, absolutely given facts that have always existed. The main problem is how to overcome those myths that contradict the cultural meaning of this subject matter.

We believe that one way of improving the situation is to confront pupils with the historical continuity in the development of mathematics by presenting them with math problems that have a historical background. For this purpose, we developed a collection of fifty problems in algebra and geometry, with a historical background and connected with the curriculum. These problems correspond to the curricula of the 8th, 9th and 10th grade and all of them appear under the same structure. We did not provided the solutions but each of the problems did present its historical background and a section called 'what else can we ask'.
We chose the approach to mathematics history through problems because:

a) A large part of mathematics creation originated from the attempt to solve problems;
b) While solving math problems with historical background, students may realize that some questions they find in the textbooks, were asked by mathematicians from the past. We hope that, in that way, students will learn how to ask questions and to appreciate the value of a good question.
c) In general, a good problem constitutes a challenge for the students and this fact may improve their curiosity and willingness to solve it. In this collection, the challenges are reachable by the students because they were chosen according to the study program;
d) During problem solving, the student is actively involved in his learning, maybe more involved than he is when listening to a lecture;
e) The historical background of a problem may contribute to locate it from the temporal point of view - who formulated the problem and why -, may help to understand the efforts made to solve it and to valorize the questions suggested by its solution. Giving such a frame to the problem may improve the significance of the problem and may also relate the topic with the students' world;
f) Problem solving is a relevant part of mathematics curriculum, so this approach is appropriate for our classrooms.

Three teachers volunteered to integrate these problems into their teaching, instead of some exercises and problems that appear in the study book. Before starting the teaching according to the research method, a questionnaire was distributed in order to test the pupils' attitudes to the integration of history into mathematics lessons. After six months of such integration, another questionnaire was distributed in order to check whether there were changes in pupil attitudes toward the integration of history. In this questionnaire we also asked whether the pupils could indicate a change in their attitude toward the subject itself. Both questionnaires were anonymous. Moreover, all the three teachers were interviewed about their impressions and opinions about the experiment.

Research findings are very encouraging. The three teachers who had participated in this study found the integration of the history of mathematics through historical problems to be positive and contributive. One teacher pointed out that whenever she started the lesson with a historical problem the pupils did not let her change the subject. Another teacher indicated that the pupils had been very excited about the fact that there was a link between the material studied in history lessons and the one taught in mathematics lessons. The same teacher said that some of the pupils who generally did not participate actively in the lesson, were very enthusiastic in participated much more in the lessons that dealt with history. About 50% of the pupils who answered the pre-questionnaire declared they were not interested in math history. After six months of study using historical problems only 16% of them pointed out that they were not interested. The percentage of interested pupils went up to 84%. The only admissible conjecture would be that pupils' exposure to the historical background of the mathematics they study in class made them become more interested in the subject. In the post-questionnaire we asked the pupils what was their attitude toward exposure to the history of mathematics through problems. About 80% of all the pupils considered the combined teaching of mathematics and the historical background as positive and interesting. The pupils' answers were categorized according to a classification system developed during the pilot research and which proved itself in the present one. We also wanted to check the change in pupils' attitude toward the subject. After their confrontation with historical problems,†twenty-three of them declared that they change their attitude. The teachers themselves pointed out the improvement of pupils' interest.

The conjecture that the integration of history of mathematics in its teaching may influence the pupil's achievement in mathematics has not yet been checked, but in view of the results of this study the subject should undoubtedly be explored.

The following is an example of the problems of the collection we developed.

Grade: 9th

Subject: Quadrilaterals, areas
Period: Ancient Egypt
2000 B.C.

Historical Background:
A papyrus which taught us about Ancient Egypt is now in Moscow. 26 of the 110 problems in this papyrus are geometric ones. Most of them deal with calculation of land area and volume of grain containers. The egyptians knew how to calculate the area of a triangle as half the product of a basis' length by the length of its correspondent altitude.
Another source for mathematics problems which occupied the egyptians are the wall paintings. A huge dedication on the walls temple in honor of Horus relates about numerous quadrilateral fields which were devoted to this god and for that purpose their area had been calculated.

Problem:
The tax collector calculated the area of a quadrilateral of sides a, b, c, d according to the following formula:

$$S = (a+c).(b+d)/4$$

Is this formula correct for any quadrilateral?
The following is a list of quadrilaterals to be checked:

a) a square
b) a rectangle
c) a rhombus
d) a trapeze

For each one of them it has to be asked whether the tax collector:
1) always lost, 2) got what he deserved, 3) always made profit 4) sometimes made profit and sometime lost, 5) another alternative.

What else can we ask?
For which of all the triangles ABC with AB = BC = 4 units, is maximal the area??