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Developing geometric proportional thinking to 6th Grade Students with the use of a historical instrument of Errard de Bar le Duc

Abstract

This paper describes a teaching experiment on the notion of proportion to a sixth grade class in Greece. The teaching was based on the incorporation of history into mathematics teaching through the study of a primary historical source and the use of a reconstructed 16th-century historical instrument of Errard de Bar-le-Duc. The importance of the work lies on the fact that it attempts to combine a geometric approach of proportion with the incorporation of history and the use of the theory of Geometrical Working Space to design and analyze the didactical phenomena.

The design of the interventions was based on the hypothesis that students can learn mathematical notions by following a history-based teaching approach that uses history as a "tool". Our work follows the principles of the "modules approach", where the historical material is the object of a project, in our case the reconstruction of the historical tool, which will ultimately lead to the discovery of its properties by the students.

The main research question was: How effective in shaping the students' proportional thinking can be an experimental geometric approach that uses a reconstructed historical instrument?

Eight didactic interventions were designed aiming at studying translated primary sources and constructing the tool based on the historical text to discover the properties of proportions incorporated in the use of the instrument and ultimately to use these properties for measurements in real space. During these interventions students worked alternatively in small groups in outdoor activities and individually in the classroom.

The implementation started in the school yard, where groups of students were assigned to estimate certain distance. The diversity of the results demonstrated the need to use an instrument to measure distance with greater precision. Then, we presented a translated excerpt of the historical text, entitled *La géométrie et pratique générale d'icelle*, which describes an instrument suitable for measuring inaccessible distances. The pupils constructed a similar instrument, according to the instructions of the text and used it during their experimental work to discover the properties of proportions of the similar triangles formed via the use of this instrument.

Finally, they used these properties to solve problems of measuring inaccessible distances and moreover to make a plan of the school environment in scale.

Our main path was to use and evaluate the idea of passing from the experiment in real space to the paper-pencil classroom environment and from the real space drawing to geometrical figures. Via these interventions we have tried to see how our students developed their geometrical - proportional thinking by passing from experimental geometry (natural geometry) to a deductive way of thinking (natural axiomatic geometry).

The evaluation was based on a pre-test and a post-test, on field observations and on a final questionnaire.

The results showed that there was clear improvement on the ability to formulate the students' mathematical - proportional thinking. They improved their performance, used more strategies to solve the problems, gave examples of recognition and problem-solving and developed the capacity to analyze quantities in a given situation. All this showed the development of the instrumental, semiotic and discursive axes of the Mathematical Working Space model.
