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Using the Fangcheng method to develop pre-algebra concepts in primary-grade students

Extended summary

The idea of integrating the history of mathematics content in mathematics teaching and learning is not new. Researchers stress many benefits of using history of mathematics in mathematics education. They suggest that it is very important for mathematics teachers to be familiar with the genesis of mathematical concepts and statements, since these might help them to better understand the difficulties students face. As a matter of fact, history of mathematics shows us that students very often form mathematical concepts in the similar way these concepts have been formed through the history of mankind. The main purpose of this study is to introduce some pre-algebra concepts, such as systems of linear equations, to primary-grade students by using an ancient Chinese method. In the first part of the paper we give an overview of the Fangcheng method. The Fangcheng method is presented in chapter 8 of the book *The Nine Chapters on the Art and Calculation* which is one of the most important and most influential mathematical works in the long history of China. Originally, the method was used for solving some real-life problems, such as calculating the yields of rice, prices of different products and numbers of animals. It deals with the solution of simultaneous linear equations with two to five unknowns by placing them in a table, and operating with columns in a way identical to the row transformations of the modern matrix algebra. In Serbia, students do not learn how to solve systems of linear equations until the 8th grade of primary school. The aim of the study was to investigate the possibility for fourth grade students to use an adapted Fangcheng method as a tool for solving word problems. The second part of the paper consists of the research

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methodology, results and discussion. We used the quasi-experimental one-group design with post-test only. There was no justified reason to include a control group since the comparison would not be possible considering that the contents presented to the experimental group were not usually taught in first four primary school grades. Furthermore, the pre-test could not be monitored since no student had had previous experience in using the presented method for solving systems of linear equations. The first research task was to determine if fourth grade students were able to learn, understand, and use the Fangcheng method when solving systems of linear equations with two unknowns. The second research task was to examine if students were able to learn, understand, and use the same method in solving systems of linear equations with three unknowns. The sample included 48 fourth grade students. The research had two phases, and at the end of each phase post-tests were conducted. In the first phase, all students participated in the intervention program, while the second phase included only those students who performed well on the first post-test (14 students). The study results indicate that students who show greater interest in mathematics successfully adopt the procedures necessary for the performance of the Fangcheng method. Furthermore, the majority of students use the Fangcheng method without any difficulties when solving text-based systems of linear equations with two unknowns within the given formed initial table. Difficulties arise when students need to mark the values and form a table on their own. A large number of students manages to understand the technique used, but due to frequent computational errors, they are unable to accurately determine the values of the unknowns. The findings of the study cannot be generalized considering the fact that there are certain limitations, such as a small sample size and quasi-experimental design. Therefore, some further research should be performed with a larger sample of students. However, since there are not many empirical researches which explore the effects of applying the history of mathematics in math teaching, we believe that our study contributes to the field. In this regard, it would be important in future studies to examine the views of teachers as to whether they apply some segments of the history of mathematics in their teaching work, for what purpose, in what parts of the class, whether their application sufficiently arouses students' interest.

Keywords: Fangcheng method, systems of linear equations, primary school mathematics, fourth grade students.

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