

## How are the Concepts of Permutation and Combination Conceived in the Minds of High School Students?

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### Abstract

Counting problems are fundamental to the development and formation of mathematical thinking, but they can be challenging for students. In order to understand the nature of the errors students make while solving counting problems, to identify the difficulties they experience, and to determine and interpret the variables that may affect the difficulties they experience, it is necessary to understand the conceptualizations of the concepts of permutation and combination that form the basis of the subject of counting (combinatorics) more deeply. In this study, it was examined how an 11th grade student who studied counting in the 10th grade made sense of the concepts of permutation and combination in his mind. The research was conducted with a case study, which is one of the qualitative research methods. The study group of the research consisted of an 11th grade student studying at a formal science high school. In the research, data were collected through a worksheet containing problem situations developed by the researcher, semi-structured interviews, and interview audio recordings. The data obtained from the worksheet and interviews were evaluated with content analysis. It was observed that the student's knowledge of the conceptual justifications of the multiplication principle and questioning his actions were effective in the abstraction of the concepts of permutation and combination and in the effective display of a successful counting operation. The study concluded that the schemas that characterize mental processes and the mental actions that form these schemas play important roles in the individual's abstraction, meaning and development of new mathematical concepts from their existing knowledge. In addition, the study suggests that teachers design activities that will use students' mental representations and reflection actions so that students can make conceptual progress, and that they support students in determining and following their own solutions in these activities.