

STUDENTS' REASONING AND SENSE MAKING ON CONCEPTS OF VARIABLES

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Algebra has an important role for students' mathematical learning. Expressions and equations are two algebraic contexts that students have to start learning from the 6th grade (CCSS, 2010). Reasoning and sense making about mathematical contexts, including algebraic topics, are very important habits that secondary level students should develop in Algebra classes (Rasmussen et al., 2011). To understand students reasoning and sense making abilities on algebra problems, especially problems asking the behavior of variables in expressions and equations, the relationships between and among equations/expressions, and the effect of varying the value of the variable, I examined 9th grade students responses on conceptual measures. Results revealed several patterns in solution methods that give a clue about the nature of students reasoning and sense making on algebra problems, hence their understanding on the basis of why a computation or algorithm works.

Participants were 300 9th-grade students from different high schools in three states in the U.S. Participants included students with and without disabilities. Data collection consists of assessment forms (concept of variable forms) that Algebra students took at the end of school semester. Conceptual assessments has been linked to the Common Core State Standards, from grade 6 through high school grades. Concept of variable form includes 19 probes with 11 multiple-choice and 8 open-ended algebra problems. As an illustration, an example for multiple-choice item is "Carl simplified $6h - h$. He said an equivalent expression was $5h$. Do you agree with Carl?"

- A. Agree, because $6h - h$ can be factored as $h(6 - 1)$ to simplify it.
- B. Disagree, because h is a common term in both so $h - h$ is 0, that leaves 6.
- C. You cannot tell if he is correct because you do not know the value of h .

D. Carl is only correct if h is a positive number." and an example for open-ended item is "Bart said, ' $w + 3$ is less than $5 + w$.' Circle one: Always true Sometimes true Never true Explain your answer." Students responses were scored based on their correct choices on multiple-choice answers and their true, partially true or wrong explanations on the open-ended items. Data analysis focused on the open-ended items to investigate the nature of students' reasoning and sense making on algebraic concepts.

Findings show that students have a pattern of the misconceptions on open-ended algebra problems. For example, more than half of the students think that they cannot compare two expressions (in above question) because they do not know the value of the variable. This study identifies several misconceptions that students have on the concepts of variables, equations, and expressions.

References

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