# ABSTRACT

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**Topic:** IDENTIFYING PROBLEMS IN STUDENTS' UNDERSTANDING OF LINEAR EQUATIONS AND TRANSCENDING THEM WITH THE USE OF COMPUTERS

**Keywords:** Understanding, Linear Equation, Computer, Algebra, Problem

Mathematics has an important place in the elementary school curriculum all over the world and particularly in India. Further, Algebra has an important place in the elementary school mathematics curriculum. Algebra is the study of structure, relation and quantity. The concepts, principles, and methods of algebra constitute powerful intellectual tools for representing quantitative information and then reasoning about that information. The central concepts of algebra include variables, functions, relations, equal sign, equations, and inequalities etc.

Even though the term "understanding" has been freely used in mathematics education literature, the search for a meaningful cognitive description of understanding has been going on for years. Historically, understanding is understood differently before and after Skemp's famous paper on "Instrumental and relational understanding", -the understanding which is distinguished from knowledge. Prior to Skemp's influential paper, researchers generally identified understanding with knowledge and it (understanding) became equated with the development of connections in the context of performing algorithmic operations and problem solving (Brownwell 1945, Polya, 1962, Lehman 1977, Davis 1978). The term 'understanding' is understood differently before and after Skemp. In the present study, 'understanding' is referred as overcoming cognitive difficulties by operating with multiple representations to construct operational and structural conceptions (of linear equation with one variable).

In the last one decade researches are focusing on students' conceptual difficulties in different areas of mathematics (Duval, 2006) in general and particularly in algebra. Researches on algebra show that students are committing errors in interpreting algebraic expressions (Booth 1984, 1988) and solving linear equation (Hall,). Students' interpretation of equal sign as an operator that produces an output(Kieran, 1981,1985a;vergnaud,1985,1988) students' inability to operate on unknown(Filloy & Rojano 1989; Bednarz, 2001; Herscovics and Linchveski, 1994) also shown in the researches. In India, studies have been done to find out the students' achievement in mathematics education as well as the difficulty areas in mathematics. But hardly a few studies have been done to investigate students' difficulties in learning mathematics and particularly in algebra by which we can make our insight what are the main cognitive obstacles in learning mathematics and particularly algebra.

The present study aimed to address the following research questions:

- What problems/difficulties do students face in solving linear equation with one variable?
- What strategies do students adopt to solve linear equation with one variable?

- What is the students' level of understanding of linear equation with one variable and its related concepts?
- How does the use of computers support students in overcoming the difficulties in understanding linear equation?

The half of the selected students of class VII from two sampled schools of Delhi Region, who come from low and medium socio-economic background and age group of 12-13 years, solved all the arithmetic operation items and more than 50% items pre-requisite for linear equations both and selected as a final sample. This study was conducted in two phases: assessing the understanding level before teaching, and teaching with computers and studying the changes in understanding level. In the first phase, the researcher collected the data from the respondents through a worksheet of linear equations and an interview schedule. In the second phase, students were engaged in teaching-learning with computer-based visual representation (NLVM software). Lesson Plans to teach linear equations with one variable through computers were developed by the researcher. There was a total of twelve sessions lasting 70 minutes each (two periods of 35 minutes each as per the school timetable). After teaching-learning sessions, a post-test (worksheet of a linear equation and interview) was conducted.

The results showed that the students exhibited the recognition level understanding of these concepts before the exposure of computer based virtual representation. The teaching intervention using a computer (NLVM Software), which was a computer based visual representation helped the students to improve their understanding of linear equation and to overcome the difficulties in understanding the linear equation. It enabled the students to shift from recognition level understanding to operational level understanding so that they could operate and solve linear equations with understanding. The majority of them improved their understanding of equal sign from 'result finder' (before teaching) to 'representing equal values on both sides i.e. 'balance' (after teaching). Majority of them admitted that unknown/variable may represent any numerical value and they responded as "any number can be assigned to unknown/variable".

If we compare the pre-test and post-test results, there was an increase in the percentage of equation solvers before the use of computers in the teaching-learning and after the use of computers. The results also indicated that the majority of students, used the transpose strategy to solve the equations before they were exposed to the use of the computers in the teaching-learning process, but after being exposed to the use of the computers in the teaching-learning, the majority used Balancing (B) strategy to solve the equation. It seemed that they understood how to balance while solving equations during teaching-learning through the computer. It indicated that students lacked a clear procedural understanding before pre-test as they multiplied or divided the number by shifting from one side of the equal sign to the other and reflected the understanding that unknown should be always on the left side of the equal sign. That was why they faced difficulties in solving the equations having unknown either on right side or as a divisor. The majority of the students were moving in a unidirectional mode of reading an equation. After teaching-learning with computers, most students showed the improvement in procedural understanding. For instance, they reflected that equal sign denotes the equivalence relationship rather than an instruction to find an answer or perform an operation.