Self-regulated learning and metacognition to enhance translation of natural language to algebraic language.

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Abstract

In this paper we present the results of a research study whose main goal is to investigate the metacognitive and self-regulated learning strategies used by secondary school students in translating natural language to algebraic language in verbal problems. In order to enhance their metacognitive knowledge and self-regulated learning and so, they become autonomous learners. We collected information in the regular classroom for a group of 18 students of third grade of a secondary school through three instruments, a test of algebra, the logical reasoning test, a self-report of metacognitive strategies, and a set of task about translating natural to algebra languages. The results of this study showed that working with the cyclical models of metacognitive and self-regulated learning had a positive impact on the translation of natural language to algebraic language. Keywords: Metacognition, self-regulated learning, algebraic translating, strategies.

The interest in knowing in depth the thinking of students who start learning algebra has led many researchers to analyze the interrelationships of algebraic language with natural language and the arithmetic. Such is the case of the interpretation of the sign = (Kieran, 1981), algebra errors (Matz, 1982), and the study on operation of the unknown of Filloy and Rojano (1989). Metacognition refers both to knowledge or awareness that one has about their own cognitive processes and products. Metacognition involves both metacognitive knowledge and metacognitive regulation. Metacognitive knowledge refers to acquired knowledge about cognitive processes in order to control cognitive processes (Flavell, J., 1987). Metacognitive regulation involves the use of metacognitive strategies. Metacognitive strategies are sequential processes that one uses to control cognitive activities, and to ensure that a cognitive goal has been achieved. These processes help regulate and monitor learning and cognitive activities involve planning and monitoring and evaluating the results of those activities. Zimmerman (1986) defines self-regulated learning as the degree to which students are metacognitive, motivational and behaviorally active participants in their own learning process. Own school is to prepare for change, training for innovation; deliver who studies, from basic education, a package of instruments and devices that train to deal with some chance of success to the challenges of the new society. Two of these strategic instruments are metacognition and self-regulated learning. The research objective: Enhance the metacognitive knowledge and self-regulated learning of secondary school students to help them become autonomous in translating natural language to algebraic language in verbal problems. Research questions: How is the translating natural language to algebraic language in verbal problems related to the components of metacognition and self-regulated learning? What metacognitive and self-regulated learning strategies are the most used by third grade students of secondary in translating

natural language to algebraic language in verbal problems? This research has a mixed approach. The study participants were 18 secondary school students of Puebla. The mean age of the students was from 14 to 15 years. Three instruments were used in this study. The self-report Metacognitive Awareness Inventory (MAI) of Schraw, G. Dennison, R. (1994) consists of 52 items. The Test of Logical Thinking , TOLT (Tobin K, & Capie W., 1984), and a algebraic test with 20 questions that were used as pre-test and post-test. First, the students responded the MAI. Then, it was explained to students how metacognitive strategies could be used and in what they consist. Second, the students responded the pre-test, and the TOLT. Moreover, a set of ten activities was applied weekly in six months as training. In the classroom, each student had to solve several word problems. Third, they met in pairs to share and, to discuss their answers. Later, the teacher organized a class discussion, inviting students to write on the blackboard the algebraic expression or equation of the problems. If the answer was correct, the teacher intervention would not be necessary. Otherwise, the teacher invited them to reflect by a verbal questioning until they reached the right solution. Finally, the students wrote down their reflections in order to deliver them to the teacher. In addition, the students responded the post-test, the TOLT and the MAI, at the end of the training. The first research question of the study concerned the relations between the academic performance and metacognition components. The results were generally as expected. Higher levels of regulation of cognition– the correlation factor was r = .50 in average, Paralleling these findings for knowledge of cognition, higher levels of declarative knowledge was r = .34 in average, The final mean of TOLT was of 5.18. It showed a meaningful increment. As well as the mean of post-test was 6.18. The second research question of the study concerned on what metacognitive strategies the most were used by students in translating word problems. The results displayed that the subcategory with the most strategies used was declarative knowledge (14.8%, r = 51). Working with the cyclical model of self-regulated learning had a positive impact on the translation of natural language to algebraic language Therefore, it contributed meaningfully to the algebraic knowledge of most students.

Matz, M. (1982). Towards a process model for high school algebra errors. In Intelligent tutoring systems (pp. 25-50).

Filloy, E. and Rojano, T. (1989). Solving equations: The transition from arithmetic to algebra. For the learning of mathematics, 9 (2), 19-25.

Flavell, J. (1987). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. American Psychologist, 34, 906-911.

Kieran, C. (1981). Concepts associated with the equality symbol. Educational studies in Mathematics, 12(3), 317-326.

Schraw, G. and Dennison, R. (1994). Assessing metacognitive awareness. Contemporary Educational Psychology, 19, 460-475.

Tobin K, & Capie W. (1984). The test of logical thinking. Journal of Science and Mathematics Education in Southeast Asia, p. 5–9.

Zimmerman, B. J. (1986). Development of self-regulated learning: Which are the key subprocesses? Contemporary Educational Psychology, 16 (3), 307-313.