USING THE LINE ARRAY REPRESENTATION AS AN ALTERNATIVE METHOD FOR UNDERSTANDING WHOLE NUMBER MULTIPLICATION AMONG PRIMARY STUDENTS

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ABSTRACT

This study aims to examine how Line Array Representation can support primary school students' understanding in single digit multiplication (SDM) and multi-digit multiplication (MDM) whole number calculations among Year 3 and Year 5 students as well as to determine its effect on the students' understanding of whole number multiplication through a multiplication test for each level constructed based on the range of calculation strategies associated with multiplication. A theoretical framework in mathematical growth which connects between the embodiment and symbolism domains was developed to examine the understanding in multiplication.The construction of multiplication concept can be examined through whether student is able to perceive, act and reason upon the line array that is considered to be the key representation for multiplication in this study. Having established the theoretical framework, the research design consists of a mixed methods approach was drawn up to conduct a qualitative study in the first phase and followed by a quantitative study in the second phase. The design is based on 'QUAL → quan Sequential Exploratory Design' which has given priority to the qualitative aspect of the study. The participants of this study were taken from an intact class of 29 Year 3 (15 boys, 14 girls) and 32 Year 5 (19 boys, 13 girls). Year 5 data was collected during an intervention in early February to mid-March 2014 while Year 3 data in mid-March to end of April 2014. Qualitative data was collected by using the teaching experiment technique. Students worked in pairs on ten SDM and two MDM tasks. Analysis of the obtained audio- and video-recordings, written tasks and field notes had identified strategies in which the Line Array Representation supported or hindered students' multiplication calculations. Results showed that students were able to apply the commutative and distributive over addition property to solve multiplication problem, most evident in 2-digit by 2-digit multiplication. Using line array, students were capable of inventing own procedures, solving MDM from the left to the right (thousands, hundreds, tens and units) obviously opposes the traditional algorithm of working from right to left. The quantitative data was collected from the 33-item multiplication test which was administered to each student before and after the intervention. The data obtained from the tests were subjected to Rasch analysis using Quest software. Overall, the resulting measures have shown to have good reliability as indicated by a Cronbach's alpha value of 0.79 for Year 3 and 0.82 for Year 5. The higher mean person estimates (Year 3 = +0.27 logits and Year 5 = +0.98 logits) compared with the mean item threshold defaulted at 0.00 logit showed that items were likely well matched for Year 3 students and easy for Year 5 students. Problems that students had faced with using the array and dilemmas that researcher encountered throughout the study are discussed. Based on these findings, two implications of this study are (1) pedagogical use of visual representations by teachers and (2) the benefits of using Item-Response Theory (IRT) model by teachers in assessments. Recommendations for further improvements in the test, structure of the line array and a different method of data collection are also put forward.