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THE ROLE OF VIRTUAL MANIPULATIVES ON THE CONCRETE-PICTORIAL-ABSTRACT APPROACH IN TEACHING PRIMARY MATHEMATICS

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This abstract presentation summarises the work to review the key pedagogical approach advocated in Singapore Primary Mathematics Curriculum – the Concrete-Pictorial-Abstract Approach or C-P-A Approach in view of the changes brought about by technological advances. In particular, the Concrete-Virtual-Pictorial-Abstract Approach or C-V-P-A Approach is proposed to take into account the role that virtual manipulatives play in enriching the representations of mathematical concepts in the mathematics classrooms.

Keywords: Virtual Manipulatives, Concrete-Pictorial-Abstract Approach, Primary Mathematics.

INTRODUCTION

The Singapore Mathematics Curriculum advocates the concrete-pictorial-abstract (C-P-A) development of concepts at the primary levels (Ministry of Education, 2006, p.7). This approach is based on the work by Bruner (1960) who stressed that for full conceptual understanding, pupils move through three stages – enactive, iconic and symbolic.

With the advent of technology, the use of technological tools is also promoted (Ministry of Education, 2006, p.19). Virtual manipulatives – dynamic representations which can be manipulated the same way as concrete manipulatives (Moyer, Bolyard, & Spikel, 2002) helps to “motivate and engage children in the learning process” (Ng, 2009, p.26)

However, there remains no clarity as to how these virtual manipulatives could be integrated into the context of the C-P-A approach in the real classroom. This paper reports on a study to address this issue by proposing and trialing a modified approach, namely the C-V & V-P-A approach. The study sought to determine the impact of this approach on:

- teacher’s delivery of lessons
- pupils’ mathematics achievement
- pupils’ engagement during mathematics
METHOD AND PRELIMINARY FINDINGS

The study basically adopts a quasi-experimental design. The participating teacher and the students involved were from a neighbourhood school at the Primary 3 level (8 to 9 years old).

Three lesson plans were used to teach the topic of “Equivalent fractions”. The lesson plans were designed using the C-V & V-P-A approach. In the lessons, a relationship between the concrete and virtual manipulatives was first established to help pupils to better appreciate the equivalence of the two representations. The development of relational understanding of concepts was then further strengthened by establishing the equivalence of the virtual, pictorial and abstract representations.

The teacher concerned was interviewed on the impact of the C-V & V-P-A approach on the lesson delivery, particularly compared to what was previously done.

A Pre-test and Post-test on fraction concepts and End-of-year Semestral Assessment scores (at Primary 2 and 3) were used to determine the impact on pupils mathematical achievement.

An adapted engagement survey with a three-point Likert scale was used to find out the impact on the engagement of pupils.

The interview with the teacher concerned revealed a better appreciation of the role of virtual manipulatives in the C-P-A approach. In fact, the teacher shared that C-V & C-P-A approach is more efficient in developing mathematical concepts than the C-P-A approach.

Preliminary analysis of the data revealed that the adapted approach may have helped to narrow down the mathematics achievement gaps between pupils. The teacher reported that pupils in the experimental group also appeared to be more engaged and motivated during the Mathematics lessons. Furthermore, the teacher also shared that the adapted approach has better helped him to plan and deliver a lesson when considering the general role played by virtual manipulatives within the C-P-A approach.

References


