Chapter 2
The Impact of Using Logic Patterns on Achievements in Mathematics Through Application–Games

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ABSTRACT

The chapter presents research into the impact of logic patterns, based on logical reasoning, focusing on order and sequence in series, on achievements in mathematics using an application-game which was developed neither specifically for the purpose of the current research nor to address Attention Deficit Hyperactivity Disorder (ADD). Both experimental and control groups were used for checking the central hypothesis on subjects of the same age – first and fourth graders at a similar learning level. The experimenters were Bachelor's Degree (BA) students majoring in special education. The method employed an application-game providing virtual simulation in real time offering the unique opportunity to observe and manipulate normally inaccessible objects, variables and processes. The focus was on qualitative research comparing subjects' achievements in mathematics in pre- and post-intervention. The findings showed that using logic patterns through the application games had an impact on the subjects' mathematical skills, especially verbal problem-solving. Their mathematical achievements increased quickly to the surprise of the experimenters who reported improvement in subjects' logic, mathematical and concentration skills, sometimes even the total stoppage of involuntary tics among those who received the intervention program as opposed to a lack of improvement or even a significant regression among the controls. Moreover, the motivation of both experimenters and subjects was enhanced, and their self-confidence improved. All the findings led to the conclusion that using application-games, although not developed for improving mathematics, can serve as a bridge between using logic patterns and improving or increasing mathematical achievements involving especially verbal problem-solving based on order, sequence and probability, among others.

INTRODUCTION

Attempting to teach mathematics in real (non-virtual) contexts, as any mathematics teacher can testify, involves many difficulties even at the most elementary level. For a very large number of pupils, these difficulties grow and accumulate with time and from one grade to the next. Simultaneously, their math anxiety (math phobia) also grows as they have nothing or very little achievement to show for the lengthy stretches of time invested in learning the subject. But by adopting a new approach to learning mathematics, following the method described in this chapter, the subjects experience significant success, aided by the guidance provided to them in the course of the experiment. They note and even emphasize that had they learned mathematics by using the method from the very beginning of their studies, they would not be experiencing so much anxiety from math studies and especially from math tests at present.

The case studies presented in this chapter were conducted by the author's Master (MA) students in physical education training and BA students, from all disciplines, training to teach mathematics, each geared to his or her teaching level, including special education. More than four hundred case studies were thus conducted by these students under the author's instruction and supervision.

BACKGROUND

Existing research sheds light on the connections between logic, mathematics and computers (Horne, 2014; Klippel, Hardisty & Rui, 2011). Logic, from the Greek logos, is both the word which expresses the inward thought, oration in Latin, and the thought itself, ratio, reason, in Latin (Liddell & Scott, 1983). Logic is the language of order (Feibleman, 1979). Klippel, Hardisty and Rui, (2011) show the relationship between logic and mathematics as innate order, i.e., classification schemes, principles of ordering, types of order; and deductive pictoralizations, such as graphs and matrices and deductive logic.

Formal and Inductive Logic

The experiments described in this chapter are the implementation of formal logic as it relates to inductive logic. The experimenters are first taught the formal logic behind the experiments and only then do they implement the inductive logic and test its results. They then study how inductive and formal logic are mutually reinforced.

The Development of Elementary Logic

Courses in introductory logic generally reflect the analysis of the connection between distinctive psychological processes and their function in organizing and guiding the cognitive development of children (Piaget, 1964). However, these courses contain only the mechanical manipulation of symbols reflecting their highly subjective mapping to structures on which thoughts are presumably strung. The development is a spontaneous process related to learning by transmission experience of equivalent situations. Yet, what normally is taught fails to account for the four stages of the child's development, according to Piaget's theory: sensory-motor, pre-operational, concrete operations and formal operations. The operational structures can be learned only using more simple and basic structures, and

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