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Comparing the Effectiveness of Using ICT for Teaching Geometrical Shapes in Kindergarten and the First Grade

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ABSTRACT

The purpose of this study is to investigate if information and communications technology (ICT) helps to improve first grade and kindergarten students' basic geometry achievement. The author's research compares the level of geometrical competence of the first grade students and kindergarten students taught using an ICT oriented learning method specifically targeting 'Realistic Mathematics Education' (RME) for geometry concepts, as opposed to traditional teaching methodology. The study dealt with first grade and kindergarten students in Crete and Athens. The experimental group of the consisted of 237 students who were taught shapes with the support of computers and the control group had 247 students. The results of the study indicated that teaching and learning through ICT is an interactive process for students at the first grade and kindergarten level and has a positive effect for the learning of shapes using the background of RME theory.

KEYWORDS

Geometry, ICT, Kindergarten, Primary Education, Realistic Mathematics, Shapes

INTRODUCTION

Teaching and learning in the 21st century requires new competencies, new cultures and new ways of experiencing teaching and learning as well as requiring motivation and specific strategies on the part of those involved in education. Educational researches, which have been occurring through recent decades, suggest that the mathe-matical difficulties students encounter later are connected with insufficient development of mathematical thinking in the early years (Van De Rijt, & Van Luit, 1998; Zaranis, Kalogiannakis, & Papadakis, 2013; Zaranis, & Oikonomidis, 2009). Thus, it becomes obvious that first grade and kindergarten classes present themselves as a very attractive environment of investigating the computer use in mathematics education. Our research reveals ICT applied in Greek kindergarten and first grade classes and explores this use of ICT for geometry education.

THEORETICAL FRAMEWORK

In the most ideal setting, information and communication technologies are treated as a tool for teaching and learning (Burnett, 2009; Papadakis, Kalogiannakis, Zaranis, 2016a; Sife, Lwoga, & Sanga, 2007). They are used as a tool for the students to become more familiar with new technology and to integrate investigation, communication and understanding across the full range of the curriculum. Particularly, in the cognitive field of mathematics an evaluation of learning outcomes regarding computer based

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mathematical teaching in students showed that computer-assisted learning can significantly help in developing proper mathematical skills and the cultivation of deeper conceptual thinking in comparison to the traditional mathematical teaching method (Dimakos, & Zaranis, 2010; Hardman, 2005; Keong, Horani, & Daniel 2005; Papadakis, Kalogiannakis, Zaranis, 2016b).

Various research results relate the appropriate use of computers with the ability of students to more efficiently understand the different mathematical notions (Howie, & Blignaut, 2009; Trouche, & Drijvers, 2010). Nonetheless, computer based activities should reflect the theoretical ideas behind them (Clements, & Sarama, 2004; Dissanayake, Karunananda, & Lekamge, 2007).

Following this principle, the software designed and the students' activities developed and examined for the pur-poses of the current study were inspired by the framework of Realistic Mathematics Education (RME). RME is an active and constantly evolving theory of teaching and learning mathematics (Van den Heuvel-Panhuizen, 2001). Indicative of this, the learning and teaching trajectories with intermediate attainment targets were first conducted for the subject of mathematical calculation at the primary school level and extended to the subject of geometry (Van den Heuvel-Panhuizen, & Buys, 2008).

In the whole trajectory of the RME teaching theory, five main characteristics of understanding geometry con-cepts are involved: (a) introducing a problem using a realistic context; (b) identifying the main objects of the prob-lem; (c) using appropriate social interaction and teacher intervention to refine the models of the problem; (d) en-couraging the process of reinvention with the development of the problem; and (e) focusing on the connections and aspects of mathematics in general (Van den Heuvel-Panhuizen, 2001). These should be the main focuses of the learning and teaching procedure concerning geometry in primary school. Following the theoretical framework that blends together Realistic Mathematics Education (RME) and the use of ICT in primary school and kindergarten, we designed a new model referred to as the Primary Shape Model (PSM) which consisted of five levels.

The main objective of this study was to compare and evaluate the effectiveness of interventions of computer assisted teaching of geometry shapes in first grade students and kindergarten students versus traditional teaching methods teachers employ to teach geometry in the control group. A number of research findings in Greece and other countries confirms that the teaching of geometry concepts in preschool and primary education with the use of computers contributed significantly more to improvements than the traditional ways of teaching (Clements, Sarama, Yelland, & Glass, 2008; Zaranis, 2011). However, the present study aims to make an important contribution to the literature by examining and comparing the effects of ICT among the first grade students and kindergarten students on teaching geometry shapes. Based on the previous studies, we set out to investigate the following hypotheses:

1. The first class students who will be taught geometrical shapes with educational intervention based on PSM will have a significant improvement in comparison to those taught using the traditional teaching method according to the first grade curriculum.
2. The kindergarten students who will be taught geometrical shapes with educational intervention based on PSM will have a significant improvement in comparison to those taught using the traditional teaching method according to the kindergarten curriculum.
3. The kindergarten students who will be taught geometrical shapes with educational intervention based on PSM will have a significant improvement in comparison to first class students who taught using the educational intervention according to the first grade curriculum.