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Use of an environment for creating multimedia educational activities in primary school. A technological mediation for the development of mental computation

Uso de un entorno de creación de actividades educativas multimedia en básica primaria. Una mediación tecnológica para el desarrollo del cálculo mental

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ABSTRACT

The purpose is to establish whether activities developed in an author's language, as didactic mediation, affect the cognitive development that allows students to perform mental calculations. It is a quantitative study of a descriptive correlational type, with a target population of 63 students in basic primary education with an average age between 8 and 11 years. It concludes that there is a positive relationship between the use of activities and the development of mental computation in students.

Keywords:

Mental computation, multimedia environment, pedagogical mediation, teaching-learning.

RESUMEN

Se tiene como propósito establecer si las actividades desarrolladas en un entorno de creación de actividades educativas como mediación didáctica afecta el desarrollo cognitivo que permite a los estudiantes realizar cálculos mentales. Es un estudio cuantitativo de tipo descriptivo correlacional, con una población objeto de estudio de 63 estudiantes de educación básica primaria con edad promedio entre los 8 y 11 años. Se concluye que existe una relación positiva entre el uso de las actividades y el desarrollo del cálculo mental en los estudiantes.

Palabras clave:

Cálculo mental, entorno multimedia, mediación pedagógica, enseñanza-aprendizaje.

Introduction

The influence of technology in the classroom has resulted in the re-signification of pedagogical practices and the need to strengthen ICT competencies for the development of good practices in teaching (Arevalo-Duarte, García-García, & Hernández-Suárez, 2019). At the Colombian level, the Ministry of Education (Mineducación) and Information and Communication Technologies (MinTIC), seek to encourage teachers to appropriate ICT skills in teaching practices (Gamboa-Suárez, Hernández-Suárez, & Prada-Nuñez, 2018; Hernández-Suarez, Prada-Núñez, & Ramírez, P. 2018), as an integral part of educational policy (Arévalo-Duarte, Gamboa-Suárez, & Hernández-Suárez, 2016).

Creating learning guidelines makes each child develop his or her own potential, both in the classroom and outside it (Tharp, Estrada, Dalton, & Yamauchi, 2002), expresses the commitment of the teacher, since he or she is responsible for the design and structuring of the educational activity that guarantees the development of competencies,

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with the purpose of transforming teaching, with an effective and active methodology and thus achieve significant and lasting learning in the student. On the other hand, today's society provides several useful and easily accessible technological mediations to improve the teaching-learning process. The use of JClic, Derive, among others, are examples of its proven usefulness in the educational field (Capell, Tejada, & Bosco, 2017; Pineda-Isaza, Hernández-Suárez, & Avendaño-Castro, 2020).

JClic, is a free open source software, which through an author tool guarantees the creation of activities such as puzzles, memory games, associations, among others, allowing to meet the needs and motivate students. On the other hand, in the field of mathematics education, one of the skills needed to evidence the cognitive development of students, mental computation, as a series of procedures that a person performs without the aid of paper and pencil to obtain the exact answer to simple arithmetic problems (Fonseca, Rodriguez, & Sanchez, 2019), has been affected by the use of calculators, PCs and cell phones; however, it has regained importance in the process of early teaching-learning of mathematics (Gálvez et al, 2011), with the use of the same technology, which motivates the power to interpret results and make informed decisions, cognitive abilities that students must develop (Barrera-Mora, Reyes-Rodríguez, & Mendoza-Hernández, 2018).

Another problem that arises is that despite the fact that the Ministry of Education has provided educational institutions with technological resources, these are being underutilized. Therefore, the design and implementation of activities is sought, with theoretical and methodological foundations (articulation between guidelines, competencies, and learning rights), supported by technological mediations (in this case the JClic), so that students can understand concepts and methods to mentally solve arithmetic problems.

Conceptual framework

JClic is an environment, developed in Java, that allows the creation of multimedia educational activities. The JClic Author is an authoring tool that allows to create, edit and publish activities on the web in a way that does not require programming knowledge (Asociación Ibn Firnás - Observatorio Astronómico de La Rinconada, n.d.), in which the teacher can design pedagogical activities, such as OVAs (Virtual Learning Objects) to enrich a learning environment (Albarracín-Villamizar, Hernández-Suárez & Rojas-Suárez, 2020), with memory games, puzzles, text activities and associations. Moreno, Anaya, Hernandez, & Hernández, (2011); Tárraga (2012) and Fernández, Nacimba, Gutiérrez, & González (2019), among others, explore the use of JClic as an appropriate mediation to favor student learning in any area of the curriculum.

In this sense, the use of ICT, such as JClic in teaching, has been seen as necessary to consolidate concepts, definitions, and procedures of the different areas of knowledge, guaranteeing the success in learning and the strengthening of the pedagogical practice (Mineducación, 2014).

Likewise, mental computation is a cognitive activity that children should develop in order to favor the learning of arithmetic, which would facilitate the teaching of later math curriculum contents. The child who masters the concept of number and arithmetic relationships is better at calculating (Baroody, 2006), which allows for the development of more complex skills that require more than the use of arithmetic operations (Formoso, Injoque-Ricle, Jacubovicha, & Barreyroab, 2017; Formoso, Barreyro, Injoque-Ricle, & Jacubovich, 2017; Formoso, Barreyro, Calero, Injoque-Ricle, & Jacubovich, 2018).

In that sense, organizations such as the National Council of Teachers of Mathematics (NCTM) of the United States, points out that students must perform calculations in different ways, which include, besides

using pencil and paper calculations, mental methods and estimations (NCTM, 2000).

Likewise, Mineducación, in its curricular orientations (Guidelines, Standards and Rights), establishes that the use (proposes, develops and justifies) of diverse calculation strategies (mental) and estimation to solve problems in additive and multiplicative situations, which give students the opportunity to make operations more dynamic and to develop ideas about numerical relations; therefore, it is necessary to stimulate them to explore and invent alternative strategies for mental calculations (Mineducación, 1998; 2006; 2016).

Method

Focus and design. A quantitative, experimental approach with the application of a pre-test and a post-test is used to determine the performance of the students in the development of their mental calculation capacity before and after a didactic mediation through the JClic.

Population. The population under study is taken as the third grade students of a public educational institution in Norte de Santander, Colombia, which is not mentioned for ethical reasons. To make up the sample, the disposition and willingness of the students was taken into account, along with the permission of the parents and directors of the institution. It is made up of boys and girls between the ages of 8 and 11, for a total of 63 students, corresponding to the 2019 enrollment.

Procedure and collection

Instrument. To collect the information, a test was developed that includes 10 items on addition, subtraction, and multiplication respectively, designed according to the Curricular Guidelines (Mineducación, 1998), Basic Standards of Competence (Mineducación, 2006), and Basic Right to Learn (Mineducación, 2016), which was applied in two stages:

Pretest. Diagnostic test that allowed to know the capacity in the mental calculation that the students had before the beginning of the mediation, which had a duration of two hours.

Postets. It was designed under the same criteria of the pre-test, as a final exam, after the intervention.

Intervention. It was based on the five keys for the teaching of mental calculus by Olsen (2015): Utility, strategy, practice, decision and mentality. For this purpose, a set of 30 JClic designed activities was applied (10 for addition, subtraction and multiplication respectively) to support the process of teaching and learning mental calculus, through exercise (repetition). These activities were carried out in the class sessions, with a duration of four hours per week during one month. In each JClic activity, students had to mentally calculate the results of proposed operations.

For the qualification of the tests (pre-test and post-test) and activities, the institutional system of evaluation (assessment scale) was used, according to the Decree 1290 (2009, art. 5), and the use of a comprehensive rubric.

Table I. Performance levels, scales and assessment rubric for tests and tasks

DERECHOS BÁSICOS DE APRENDIZAJE GRADO 3: Propone, desarrolla y justifica estrategias para hacer estimaciones y cálculos con operaciones básicas en la solución de problemas.		PENSAMIENTO Y SISTEMAS NUMÉRICOS ESTÁNDARES BÁSICOS DE COMPETENCIAS PRIMERO A TERCERO: Uso diversas estrategias de cálculo (mental) y de estimación para resolver problemas en situaciones aditivas y multiplicativas.
Nivel de desempeño	Escala de valoración	Descriptor
Superior	4.5 a 5.0	Resuelve todas las operaciones de suma y multiplicación, mediante el uso del cálculo mental.
Alto	4.1 a 4.4	Resuelve las operaciones de suma y multiplicación, mediante el uso del cálculo mental.
Básico	3.0 a 3.9	Resuelve ciertas operaciones de suma y multiplicación, mediante el uso del cálculo mental.
Bajo	0.1 a 2.9	Resuelve con dificultades las operaciones de suma y multiplicación, mediante el uso del cálculo mental.

Source: Institutional system of evaluation and promotion

Results and discussion

The results between the pre-test and the post-test are analyzed by means of a comparative analysis between the ability to calculate without the technological mediation and to measure it mediated by the JClic.

Table II. Levels

		BAJO	BÁSICO	ALTO	SUPERIOR
Adición	Pretest	37,9%	12,1%	0,0%	0,0%
	Postest	18,2%	27,3%	4,5%	0,0%
Sustracción	Pretest	34,8%	13,6%	0,0%	0,0%
	Postest	18,2%	27,3%	4,5%	0,0%
Multiplicación	Pretest	42,4%	7,6%	0,0%	0,0%
	Postest	33,3%	16,7%	0,0%	0,0%

According to Table II, when analyzing the results of the pretest, it is observed that the student's mental calculation skills are at the low level, being more representative in the multiplication, which indicates that this is not the chord according to the established in the Guidelines, Standards and DBA (Mineducación, 1998; 2006; 2016). This may be due to the fact that the child's development is not adequate due to multiple factors that may affect his or her capacity to learn and attitude towards learning that originates in these years (United Nations Children's Fund - UNICEF, 2017) at the beginning of the school stage.

In addition, knowing the cognitive skills that influence mental computation allows us to identify early indicators of difficulty in mathematics and comprehensively address its intervention (Formoso et al., 2017; Formoso et al., 2017) for the subsequent acquisition of more complex skills (Formoso et al., 2018).

In making the comparative analysis between the pre-test and the post-test, it is evident that after the application of the activities there is an advance in student learning toward the level of basic performance, with greater development in addition and subtraction, compared to multiplication, which is one of the most difficult skills that schoolchildren have to acquire in primary education (Álvarez-Montesinos, Costa, & García-Orza, 2018). However, there is a need to carry out a more rigorous validation process for the tests used, since having valid instruments allows us to obtain reliable results about the development of mathematical skills in children (Formoso et al., 2017).

In summary, the didactic mediation of the JClic improves the mental calculation of the students under study. The didactic means supported by JClic favour the development of the logical mathematical skills and allow a better evaluation of the acquired knowledge (Fernández et al., 2019). But in this study, it is necessary to extend and improve the didactic intervention, since the results obtained do not reach the high and superior levels.

It is highlighted that for the group under study, the use of technological mediation generated motivation, which was evident in the students at the time of carrying out the activities in comparison with tools such as pencil and paper. This evidences the pedagogical benefits of ICT and how they influence the teaching-learning of mathematics (Quintero & Jerez, 2019). The JClic allows the design of didactic activities without the need of having a high technological knowledge, with a low investment of time, and with interesting results for the classroom work, in the stages of pre-school and primary education (Tárraga, 2012).

Conclusions

The inclusion of the JClic in the teaching-learning process of mental calculus offers the possibility of improving the student's ability, through environments that enhance their participation in the proposed activities. It is necessary to emphasize that the level of the students before the intervention was basic, since the students did not have a development of the mental calculation. In addition, the use of JClic in their academic activities, motivated the students in the realization of the tasks compared to traditional elements such as pencil and paper. Finally, it is concluded that there is a positive relationship between the use of JClic as a didactic mediation and the level of mental calculation in the students under study, but this result is not conclusive because it does not allow a generalization about its use in the

development of these skills, because the sample of students was not large. It is also necessary to carry out a more rigorous validation process to the tests used.

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