Logo-based activities for learning counting for children with Down syndrome

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Abstract

In this paper we present four Logo-based activities that were designed as part of a study to help children with Down syndrome (DS) learn counting and the concept of quantity, through the construction of figures and paths. The activities were piloted with a couple of normal 6 year-old primary school children and then tried out with three children with DS of 12-13 years of age. Some of the activities were easier and more enjoyable than others. In regards to how the activities helped these children in the learning of counting, the study was inconclusive, though the children with DS did show much more engagement with the computer-based activities than they had done with other concrete materials and did show progressive improvement over the sessions that may indicate they derived some benefit from engaging in these activities.

Keywords

Down syndrome; children; counting; Logo; constructions

Introduction

We present here a research project that intended to help children with Down syndrome (DS) develop their abilities in counting and the concept of quantity through their engagement of some Logo-based activities that involved constructing figures and paths. We begin by discussing some of the challenges that persons with DS face; then present the activities and finish with some results from their implementation with three 12-13 year-old children with DS.

Some of the challenges for people with Down syndrome

Persons with Down syndrome (DS), besides having some physical afflictions, also have some intellectual and cognitive handicaps. They tend to be slow to process and codify information, and have difficulties in interpreting it. They also have difficulties in dealing with several variables at once. Additionally, their spatial and temporal orientation is not as well developed; they also have problems with arithmetic computations, particularly mental ones. In terms of memory, though they can have some difficulties in retaining information, they have well-developed procedural and operational memory, so they are capable of carrying out sequences of tasks with precision. On the other hand, they have difficulty following a sequence of more than three instructions. Their visual retention capacity is higher than their auditory one (Flores & Ruiz, 2004). One of the areas of biggest handicap, is the area of language. Persons with DS tend to have a late emergence of language and language skills, although this is highly variable amongst individuals (Miller, 2001, in Flores & Ruiz, 2004).

From an educational perspective, the above issues have some implications which need to be taken into account. First, the attention-deficit problems that persons with DS tend to have, imply that instructions need to be given more gradually in a detailed and precise way. Since visual processing is easier than the auditory one, the visual channel should be emphasized, particularly for giving information. In general, teaching needs to be gradual and individualized since different children require a different number of repetitions and also have different response-times (Ruiz 2006).

Taking the above into consideration, and inspired by the work carried out by Weir (1987), we believe that computer-based activities can be helpful in the teaching mathematical content to children with DS (as has been shown by researchers such as Ortega-Tudela, 2008): for example, by helping in the information perception and processing. Also, computer activities can be more adaptable to the individual needs that persons with DS require.

On counting

Counting requires putting into correspondence objects in a set, with the conventional set of natural numbers. The first methods of quantification are *subitizing*, which refers to the process by which small sets are immediately quantified without the need to count all of its elements; and *estimation*, used for larger sets to guess its number of elements without really counting the elements. In more advanced stages of counting, it involves one-to-one correspondences; stable order; cardinality; abstraction; and irrelevant order (Gelman & Gallistel, 1978).

Baroody (1988) showed that children with slight mental retardation (not specifically with DS) were capable of counting. However, other researchers have found that mentally retarded children exhibit learning by repetition rather than understanding the basic principles of counting (Brown & Deloache, 1978; Cornwell, 1974); this implies a restriction in the flexibility towards counting: thus, when children with DS learn to count by ordering objects, they later have many difficulties in changing those structures.

Logo-based activities for promoting the learning of counting

Figura 1. Interactive button area for the first activity (left) and second (right) activities

In order to try to help students with DS learn counting and the concept of quantity, we designed some activities for them, using MSWLogo. As will be further described below, these activities involved constructions by the children of figures made out of squares blocks, or of paths; in order to successfully carry out the activities, children had to count, though they also learned through trial and error. Because of their limitations in using language, we created buttons for them to move around and add or remove objects such as squares (see Figure 1). The commands were very basic (up, down, left, and right) and placed in a manner similar to the movement arrows on the computer; as well as other simple commands, such as for adding (*Pon*) or removing (*Quita*) the square blocks with which they would draw (see activities below); we also included a New (*Nuevo*) button to clear the screen to begin a new drawing. Also, although we included some text

in the activities, this was read and explained to the students.

The Drawing with Squares activity

The first activity (Figure 2) came about due to the interest that the children had in using a computer program to draw. With this activity, children could draw figures by adding squares or blocks (one at a time). We wanted to use it to see if the children realized that when the complexity of the drawing increased, it was because they were using a bigger number of squares.

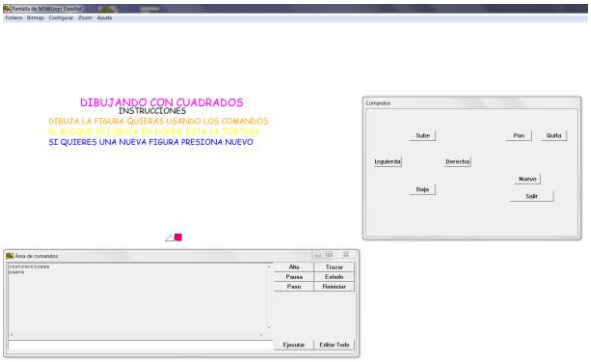

Figure 2. Initial screen of the Drawing with Square Blocks activity

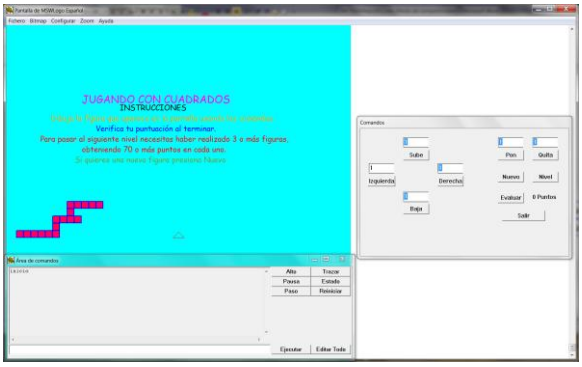

Figure 3. Initial screen of the Playing with Blocks activity

The Playing with Blocks activity

In the second activity (Figure 3), a figure is given and students have to reproduce it. The activity is presented as a game that gives points for achieving correct enough figures. Students have to build at least three figures of a minimum of points if they want to be able to go on to a next level.

In this activity we added the possibility to add (or remove) or move by more than 1 square block, to see if students would count the blocks in parts of the given figure and add the corresponding amount in their own drawings.

The Labyrinths activity

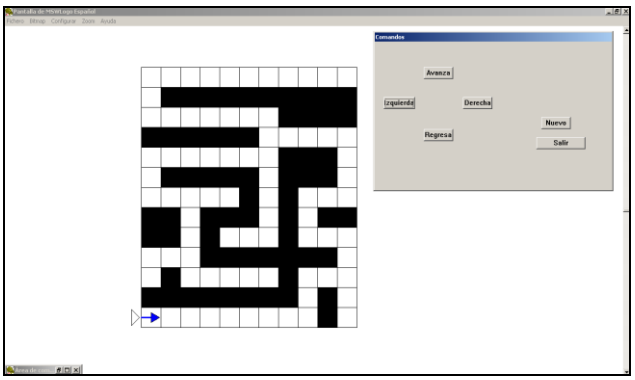

Figure 4. Initial screen of the Labyrinths activity

In the third activity (Figure 4), we not only wanted for the children to work with counting but also with laterality. An important difference of going through the labyrinths on the computer vs.

doing it with pencil and paper, is that the children are forced to specify how many steps (in this case squares) the Logo turtle has to walk and in which direction. We designed a set of 10 different labyrinths with different levels of complexity through which children can progress as part of the "game".

The Following Paths activity

The fourth and last activity, was the most complex one. Here, children could construct one of three paths to reach the goal. We included a number line and an operation line to record the steps taken in terms of what had been added and subtracted along the path, so that children could see these numbers and operations with the aim of helping them develop number and operation sense.

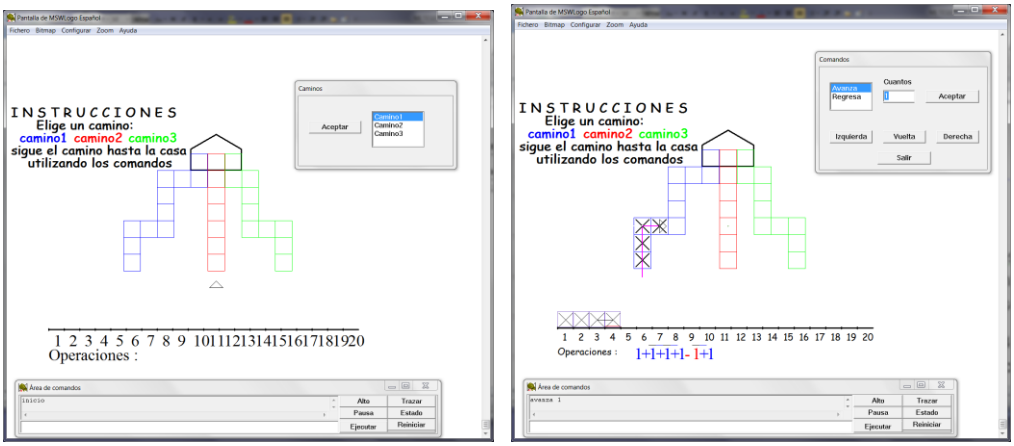

Figure 5. Initial screen (left); and screen half-way through the Following Paths activity (right) where the operations showing the steps added (or subtracted) are shown below.

Some results

The activities were piloted with two normal 6 year-old children in primary school and then were carried out with three children (two girls and a boy) with DS, of 12-13 years of age, that studied in a public school for children with special needs (called Center for Multiple Attention) in Tlaxcala, Mexico. The normal children very successfully carried out the activities, engaging in them, enjoying them very much (particularly the game in activity 2), and also displaying much creativity. The DS children initially needed a period to learn to play and move, understanding what each button did, as this was not straightforward for them. In a second session, children enjoyed randomly creating some drawings. One of the girls, whom we call here Monica, did not like pressing the buttons herself with the mouse or keyboard, so she would point at the screen at what she wanted and the teacher would press them for her.

The boy, whom we call here Israel, spent the second session filling out the screen with random paths. On the third day, he began wanting to draw closed figures (although he had some trouble distinguishing between left and right). On the fourth day, he enjoyed drawing "paths" as he called them, and also began wanting to construct a square, but had some difficulties. The next day he finally achieved drawing a quadrilateral on his own (Figure 6) and with no help from the teachers. But he remained obsessed with drawing closed figures: even when he wanted to draw a staircase, he had to draw a staircase as a closed figure (Figure 7). Monica also achieved constructing a square, also on her own (though by directing the actions to the teacher); she liked to "direct" drawings but did not show much interest in the other activities.

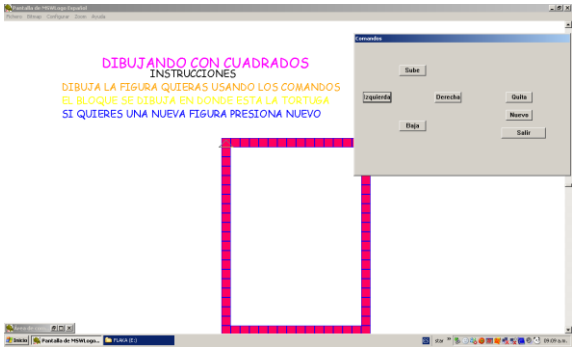

Figure 6. Israel's first quadrilateral.

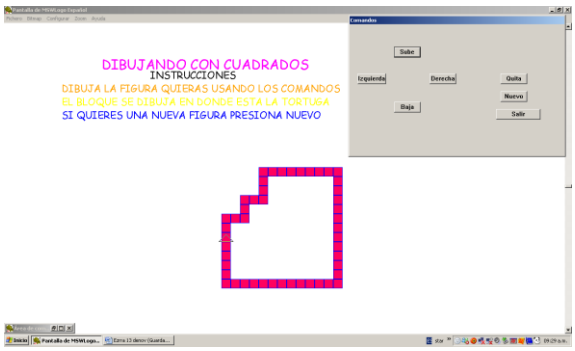

Figure 7. Israel's staircase.

We started the third activity (the Labyrinths activity) about a month after the children had first started with the computer activities, but we always had to combine this activity with the drawing one, since it was the one children enjoyed the most (possibly because it was the most constructionist one of them all). Through trial and error (i.e. correcting their wrong turns) children were able to solve the labyrinths: Israel realized after a couple of sessions that if he made a wrong turn, he could correct it by turning more times in the same direction.

The fourth activity turned out to be too complex for these children, and they kept asking to go to the drawing activity, so we couldn't work on this one much.

In regards to how the activities helped these children in the learning of counting, the study was inconclusive (we used pre- and post- assessments to measure their counting abilities: only a mild improvement was detected), though there was some indication that with more time working with them, we may have achieved better results. Israel did learn to name numbers, though. More significantly, the children showed much more engagement with the computer-based activities than they had done with other concrete materials and did show progressive improvement over the sessions: their drawings became more complex and they were able to construct them on their own, which is indicative that they benefited from engaging in these activities.

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