Project number: 2018-1-IT02-KA201-048274

Intervention Tool

Scales, weights and first degree equations

1. Introduction

This intervention tool aims to help students with difficulties establishing a relationship between an equation and a balanced scale and in translating the situation into mathematical language.

2. Theoretical framework of reference

Karagiannakis's and colleagues (2016), propose a model classifying the skills involved in learning mathematics into four domains: core number, memory, reasoning, and visual-spatial. The results of their research support the hypothesis that difficulties in learning mathematics can have multiple origins and they provide a means for sketching students' mathematical learning profiles.
The herein described intervention tool is related to the Reasoning domain as well as with the mathematical domain Algebra since the students are asked to establish a relationship (between an equation and the balanced scale) and perform calculations.

1) From another point of view, the **Center for Applied Special Technology** (CAST) has developed a comprehensive framework around the concept of Universal Design for Learning (UDL) - http://www.udlcenter.org - with the aim of focusing research, development, and educational practice on understanding diversity and facilitating learning; UDL includes a set of Principles that focus on individual differences as an important element to understand and design effective instruction for learning. To this aim, UDL advances three foundational principles: 1) provide multiple means of representation, 2) provide multiple means of action and expression, 3) provide multiple means of engagement.

2) Another theoretical reference comes from the **European Project FasMed,** focused on formative assessment in mathematics and science, (https://research.ncl.ac.uk/fasmed/), conceived as a method of teaching where information around the student's accomplishments is interpreted and used by instructors, learners, or their peers, to make choices about the following steps.

3. Design

In the subsections, the activities of the intervention tool are presented in detail**:**

3.1. Difficulties identified through the B2 questionnaire

The difficulty identified in B2 to which this intervention tool is directed is solving degree 1 equations that are the core of questions like 'if a is equal to 3, what is the value of 2a+1?' (question 22).

3.2. Cognitive area and math domain of interest

Reasoning/Algebra.

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3.3. Educational Aims

This intervention tool aims to help students with difficulties establishing a relationship between an equation and a balanced scale and in translating current life situations into mathematical language.

3.4. Addressing to Student /class

This intervention tool may be addressed to the whole class.

3.5. Educational activities: the Intervention Tool

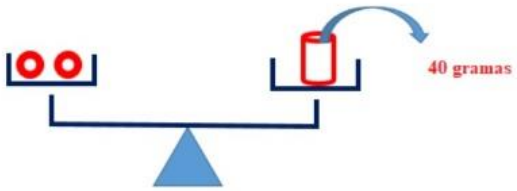
It is expected that this activity provides an opportunity to work the student's self-regulation and persistence (UDL principle *Engagement*), improve the ability to set goals and strategies to achieve them (UDL principle *Action and Expression*) as well as the skill of decoding mathematical language, syntax and symbols and activating background knowledge about algebraic expressions and manipulation of variables (UDL principle *Representation*).

The discussion that will arise throughout the experience will allow the teacher to informally evaluate the students' comprehension and progress and identify concepts that students are still struggling to understand so that adjustments can be made to future lessons, therefore allowing formative assessment.

Required material:

- Scale of plates.
- Tokens and weights.
- Paper and pencil.

1. Consider the balanced scale, represented below.



In one of the scales' plates there is a weight of 40 grams and in the other plate there are two equal disks.

a) How much does each disc weigh?

Indicate all performed calculations and reasoning.

b) Represent the weight of a disk by y and write a mathematical expression that translates the described situation.

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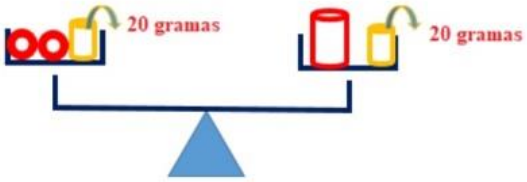
2. Now consider that another 20 grams weight has been added to each of the plates.



a) Will the balance remain balanced?
b) What will the weight of each disc be now?
c) Represent the weight of a disk as z and write a mathematical expression that translates the described situation.
d) What do you conclude about the calculated y and z values? Are they the same or are they different?

3. Now suppose you have balanced scale with a 100 grams weight, on one of the plates, and four 25 grams discs on the other plate.

If you double the number of discs, how many grams do you have to put on the other plate for the balance to remain in balance?

4. References

[1] Karagiannakis, G. N., Baccaglini-Frank, A. E., & Roussos, P. (2016). Detecting strengths and weaknesses in learning mathematics through a model classifying mathematical skills. Australian J. of Learning Difficulties, 21(2), 115–141.

[2] Oliveira, H., A Álgebra no Novo Programa de Matemática do Ensino Básico, Educação e Matemática, 105, 83-86, (2009).

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