A FRAMEWORK OF DESCRIPTORS TO CHARACTERIZE FLEXIBILITY AS A TRAIT OF MATHEMATICAL GIFTEDNESS

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Theory

Introduction

Mathematical creativity is considered as constituent of mathematical giftedness (MG). It consists of three components, one of them being flexibility (Kattou et al., 2013; Leikin & Lev, 2013).

Objectives

- To present a theoretical framework characterizing flexibility by means of a set of descriptors useful to analyze students' problem-solving processes.
- To present the particularization of those descriptors to some types of problems often used to identify MG students.

Flexibility

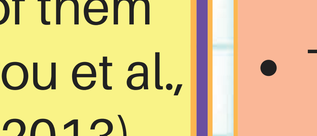
Ability to change the way of solving a problem when the conditions of the problem change or when, during the solution, an obstacle or a more interesting new idea arises (Krems, 1995; Kozlowski et al., 2019; Leikin & Lev, 2013; Siswono, 2011).

Descriptors of flexibility

- **Systems of representation**
  - change or combine systems of repr.
- **A new way of solution**
  - because a blockage
  - current way is long or complex
  - a new idea arises
  - changes in the statement
- **Multiple solutions** differing on
  - representations
  - strategies
  - order of steps

Examples

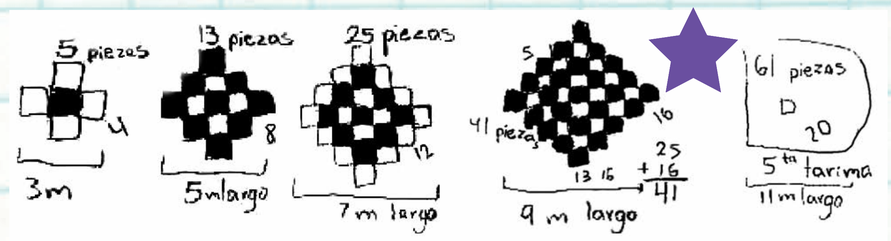
A company places platforms formed by squared tiles of 1m x 1m, in black and white colors, as shown:

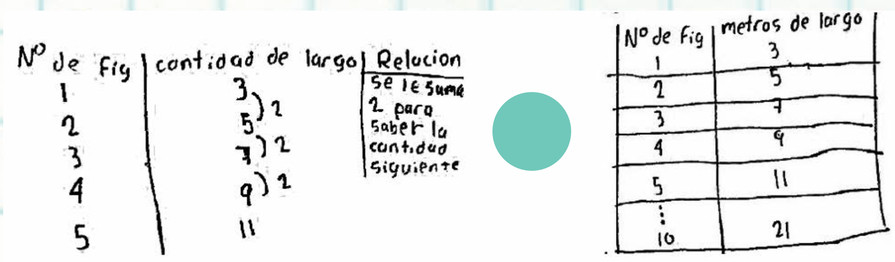


They can place small platforms (3m wide, as the platform on the left) and larger platforms, following the same pattern and using black and white tiles.

a) If the pattern shown is continued adding the 4th and 5th platforms, how many tiles are used to build the 5th platform?

b) How many tiles are used to build a 21m-wide platform?





Cristina is visiting the country of Fruitland, whose currency is the *Frut*. She wants to prepare the typical dish of the country, which contains banana, pineapple, orange, and apple. When buying the fruits, she noticed that:

- 2 oranges cost the same as 6 bananas.
- 1 pineapple costs the same as 3 apples.
- 2 apples cost the same as 4 oranges.

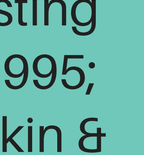
a) If each banana costs 4 *Fruts*, how many *Fruts* does a pineapple cost?

b) To verify your answer, solve the problem again, in a different way than before.

a) 6 bananas cost the same as 2 oranges, each banana costs 4 Fruts and 2 oranges cost 24 Fruts. If we double it, they [4 oranges] cost 48 Fruts and 2 apples cost 48 Fruts and, if we add the price of an apple to that of 2 [apples], we have that a pineapple costs 72 Fruts.

b) I got the equivalence of 3 apples with 6 oranges. For 2 oranges we get 6 bananas and then 6 oranges are 18 bananas, and 1 pineapple is 18 [bananas], so it costs 18x4 = 72 Fruits.

Jasmine has built a big cube with small cubes, but she did not have enough cubes, so she has left a few full rows empty, as shown in the figure.

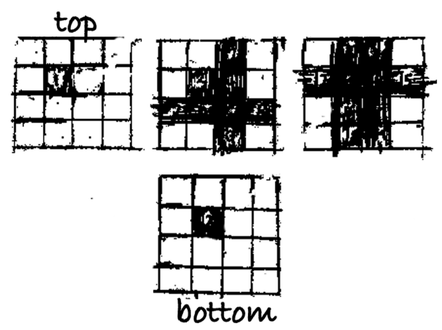


How many small cubes does Jasmine need to fill in the empty rows? Justify your answer.

6 holes
4 squares each hole
The holes collide 4 times

6 × 4 = 24
24 − 4 = 20

Jazmin needs 20 cubes to complete the big cube, because if we see the big cube by lawyers from top to bottom, we can realize that 20 are missing.



Conclusions

We have presented:

- An innovative characterization of mathematical flexibility by means of a set of specific descriptors observable when MG students solve problems.
- Several types of problems that are effective to observe students' flexibility and to identify MG students.
- The particularizations of some descriptors to those types of problems.

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PID2020-117395RB-I00 (MCIN/AEI/10.13039/501100011033)
Proyecto 820-CO-081 de la Universidad de Costa Rica