Reporting an "effective" task selected/designed and enacted in the context of the EDUCATE project

Mathematical topic:
This problem is an nrich problem called "six numbered cubes" (https://nrich.maths.org/10918). It gives pupils the opportunity to use knowledge and skills associated with spatial awareness, addition and multiplication, and to explain their thinking. It also involves keeping to rules that must be followed.

Educational Level: 4th class

Age group: 8-11 years

Duration of the lesson: 50 minutes

Learning goals: The aim of this challenge is to find the total of all the visible numbers on the cubes. This problem gives the pupils the opportunity to use knowledge and skills associated with spatial awareness, addition and multiplication. It also involves keeping to rules that must be followed. It gives the pupils the opportunity to use a whole variety of problem-solving skills.

Description of the task and its rationale in terms of mathematical challenge and differentiation: Please identify and list/present/describe the main (challenging) task considered in the lesson.

Each group of four children has six cubes. Each cube has six faces of the same number.

The students were asked to find the highest total that they could make using this staircase shape and the cubes?

I wanted the students to work together to solve this problem
I required them to explain to each other what they were doing as they solved the problem.
I asked a member from each group to explain how they calculated the total making sure they gave reasons for their method/s. Other groups were encouraged to question them about their reasons.

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Task introduction
I first gave each group 6 cubes and explained that they were to use all the cubes to build a staircase using the 6 cubes. I built my own staircase and counted the total **find the total of all the visible numbers on the cubes.** Then I asked the students to put the cubes together in any order and to find the total that they made using the six cubes. Then each group gave us their different totals. We discussed why they got different totals.

Student autonomous work
The students were then asked to find the highest total they could make with the six cubes using this staircase shape.
They had to explain each decision they wanted to make to the others in the group. Each total was to be written down and discussed.
Why was this total bigger/smaller than the previous one?
Where is the best place to put the cubes to make the biggest total?
Why?
There are many different levels of challenge and differentiation in this problem.

1. You start by using the staircase and asking the students to find the total of all the visible numbers on the cubes.
2. They find the highest/lowest number that could be made using any shape of single cube thickness
3. Can you organise the cubes so that all the visible numbers add to 75?

4. Prove the following by logical reasoning, rather than by calculating the answers: If the cubes are arranged in a single vertical tower (like this)

then whatever the order of cubes you make you cannot produce a total of 80.

Whole class discussion
This problem gave the pupils the opportunity to use knowledge and skills associated with spatial awareness, addition and multiplication. It also involved keeping to rules that must be followed.

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It gave the pupils the opportunity to use a whole variety of problem-solving skills. When the autonomous work was completed each group reported back on the highest total they got. Two groups got the same number and two got lower numbers. One of the students from the groups who got the larger number explained how they had organised their cubes to get that number. Other members of those groups explained why they put the cubes where they had put them. The other two groups then spoke about what they did and why they had gotten a smaller number. All groups were encouraged to question other groups on their work.

- Where do you put the cubes to get the biggest number?
- Which cube should show most faces?
- Why?
- What changes do you make to show the smallest number?
- Why do you think that?

Reflection

The problem worked well. All the students were engaged and took part in solving it. They all enjoyed it. It encouraged them to think carefully and to explain their thinking. In my opinion this was an excellent problem to encourage the students to explain their thinking. Some of the students were able to solve previous problems but found it difficult to explain to others what they did. However, this is good problem to discuss. Some students who would normally have difficulty were able to understand when others explained their thinking. Those who completed the first part had other levels of challenge available to them. However, we did not get to complete the 4 levels as a class due to lack of time.

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