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Exploring the Role of Self-Generated Analogies in Solving and Reasoning about Novel Situations

Nikolaos.Fotou@nuim.ie

"The whole of science is the refinement of everyday thinking"

(Einstein, 1936)

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Analogy

Analogy ➡ symmetrical relations between two or more things that are compared

Analogies have two main components:

the base and the target.

the known situation which forms the basis to approach the target.

the unfamiliar situation that is under examination.

Analogies are valuable as tools for reasoning and understanding

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better understanding of novel situations by allowing to see similarities between the unfamiliar and the familiar, between what is new and what is already known (Goswami, 1992; Kim & Choi, 2003).

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The research questions:

a) What predictions do students make about novel situations?
b) How do students of different ages make predictions about novel situations?
c) To what extent do students generate analogies in order to make their predictions?
d) To what extent do students of different ages draw upon similar analogies?

- Study carried out in Greece.

  - Ten different schools in Greece took part.

  - Multi methods - combination of interviews and questionnaires.

Methods

- A sample of 166 students:

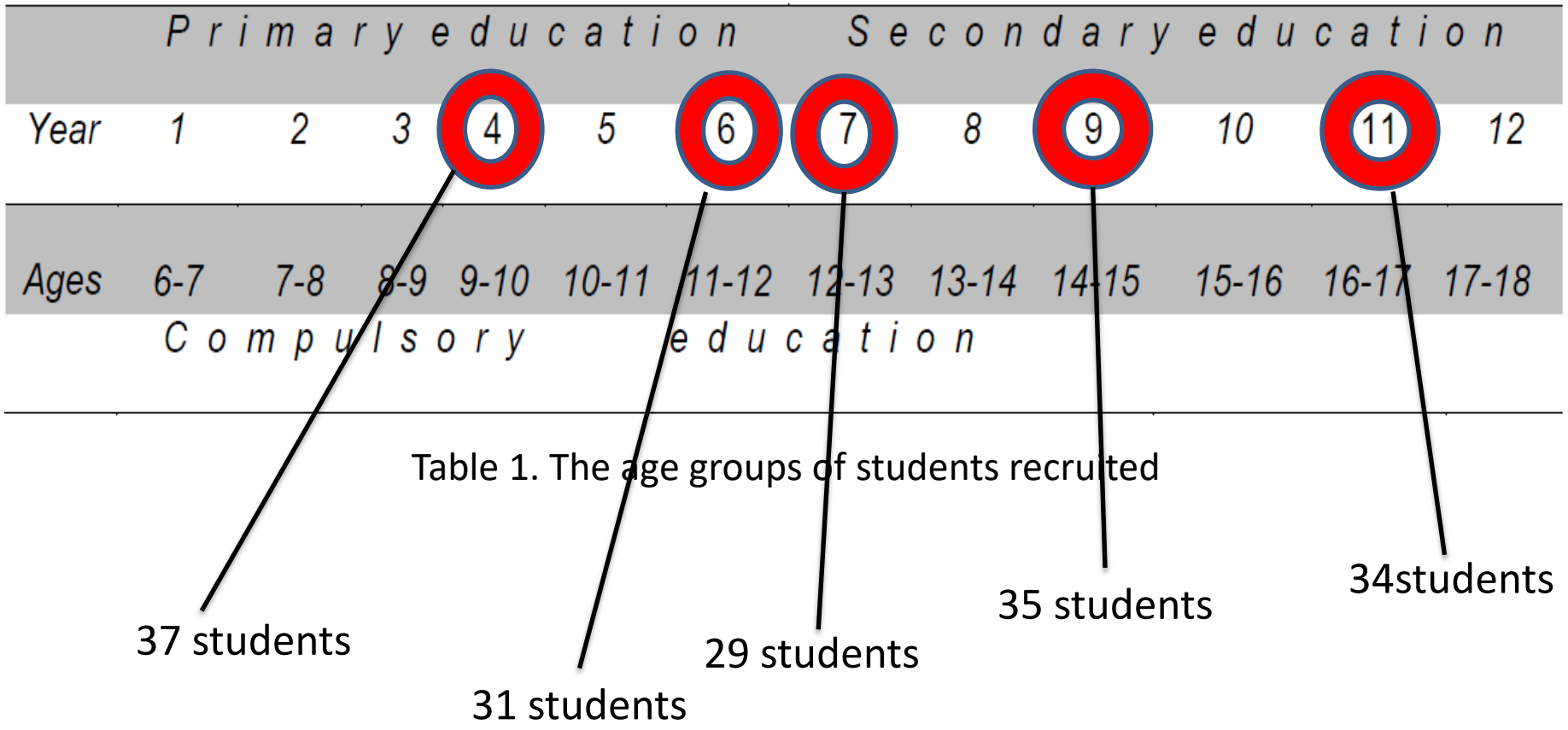

Table 1. The age groups of students recruited

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The questionnaire

When the ice-cube melts, which of the three arrows will point at about the same level as the water level in the glass?

A)Arrow A B)Arrow B C)Arrow C

What makes you think that?

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Ice cube is nothing more than frozen water and if it melts, water will be added in the glass. I have observed in winter the road being full of snow and afterwards full of water and that is why I think water will be added.

(4th grade student)

Ice is made of water. Thus when it melts, water is added in the glass. It is similar with what I have heard about the level of the sea; If ice-bergs at the North/South pole melt the level of the sea will rise.

(9th grade student)

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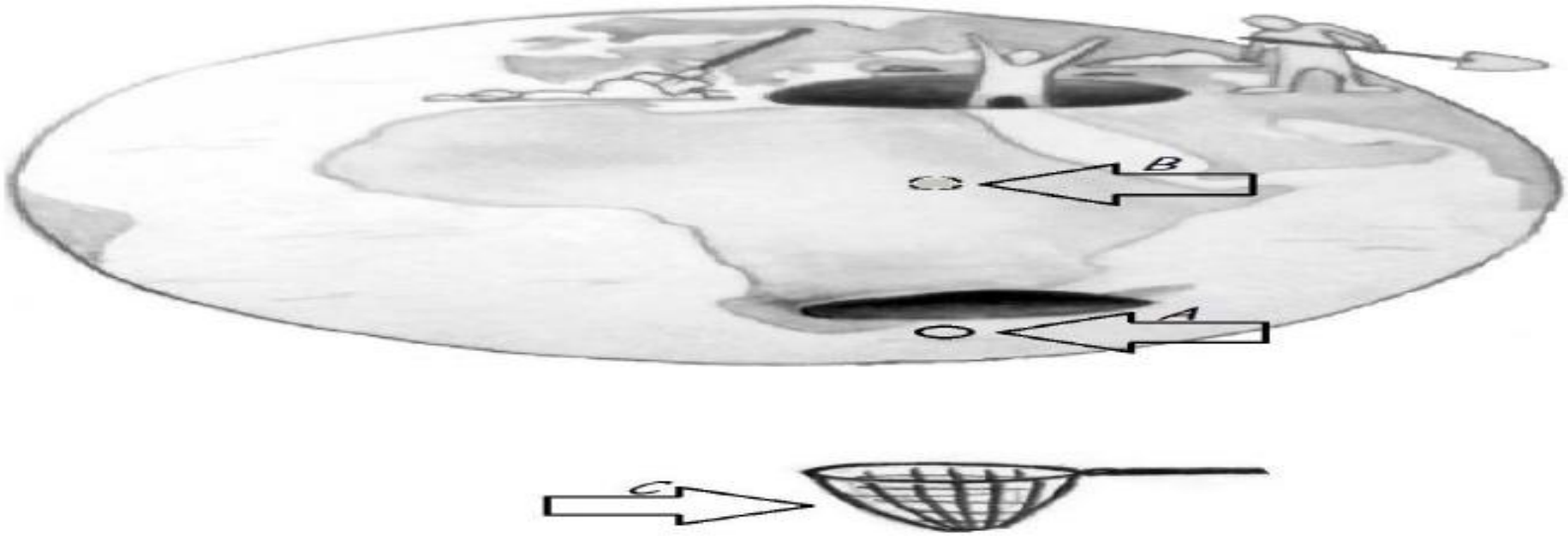
The novel situations-Results

Novel situation 1: Objects falling in holes dug into the Earth



Two people have dug a huge tunnel straight down from the one side of the earth to the other (as shown in the figure) and one of them jumps in. Where will this person stop?

A) On the other side of the tunnel

21%

5 out of the 30

B) In the middle of the tunnel

12%

1 out of the 19

C) In the net

70%

66 out of the 117

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I think that the person will fall into the net. It is like the holes we dig on the beach. When I do so, I can see water going from the one side of the hole to the other.

(4th grade student)

I chose A. I think that the person will stop on the other side of the tunnel. I have observed that when you drop a thing in a hole it falls downwards. However the person cannot stop in the net; he cannot escape from the Earth's gravity.

(11th grade student)

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Results-Discussion

- 226 correct answers out of the 996 predictions (≈23%). There was not statistical significant difference between students' predictions and their age.
- At least 4/9 students did use an analogy in order to make their predictions in the 6 novel situations. Statistical analyses demonstrated no interaction between age and the use of analogies.
- The vast majority of the analogies identified were spontaneously generated

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- The most common method for generating analogies among this study sample was that based on transformation of the original situation.

- Comparing students from primary and secondary education, there was a close correspondence between achievement and the use of analogies.

- Spontaneously generated and self-generated analogies seemed to play a key role in the perception of novel situations.

- Most of the analogies generated were based on familiar ideas from personal and daily experiences.

- Students across a wide age range appear to use the same or very similar analogies

- Many students were led to erroneous predictions because of reasoning spontaneously using incorrectly the same everyday analogies.

- There were students in secondary education who used an analogy and made a correct prediction.

- Similar reasoning processes and the use of the same analogies does not always lead to an incorrect prediction (experiential knowledge was beneficial).

- Others who chose the correct option reasoned on the basis of their scientific knowledge.

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This suggests that students, especially as they grow older, have made their observations well and they can use this experiential knowledge in such a way leading them to correct predictions and a subsequent better understanding of situations/phenomena.

Moreover, there were few cases in which older students (secondary education), who made a correct prediction, not only showed a correct understanding of the scientific concepts but also, used these concepts as the basis of their analogy generation.

As Huxley (1894) wrote about science education, “all truth, in the long run, is only common sense clarified.” (p.282).

Therefore, it is important for students to be given the opportunity to connect reasoning in science with their common sense which, as the study showed, is actually their way of reasoning in their everyday life.

Key references

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