Can you tell who's more creative than me?

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Abstract

The definitions of creativity from de Bono (1982), Munari (2015) and Young (2003) suggest that creativity involves forming new ideas by connecting pre-existing unrelated ideas, in a structured process. This paper argues that individuals with broader knowledge repertoires can be more creative, implying that, when they have to deal with typical school knowledge, educated adults are potentially more creative than children, contrary to the prior assumption that children are more creative. Results from a workshop[1] attended by 17 primary science teachers from the UK are presented and analysed, in which participants were asked to consider how the human body could be 'improved' and to present their ideas in a drawing. The results obtained in this workshop were compared with those achieved by children aged between 5 and 13 years in previous studies from other authors. In terms of creativity, when children or adults are asked to draw 'improved' human bodies, adding or deleting organs or features, less than 20% of the former give answers that include some creativity (de Bono, 1982), in contrast to adults, where close to 70% present some creativity in their drawings. Thus, the results suggest that broader repertoires of typical school knowledge generate more creative responses, causing the authors to argue for the consideration of knowledge expansion to support creativity.

Keywords: Creativity, children's drawings, human body, repertoire of knowledge

[1]The workshop was presented at the Primary Science Education Conference (Edinburgh, June 6th-8th, 2019). The workshop had 18 teachers enrolled and was attended by 17 of them.

Introduction

Definitions of creativity range from very simple definitions (those that refer to creativity as the production of ideas, products or solutions that have value (Stein, 1953)), to those that consider it the highest form of thought (Anderson & Krathwohl, 2001).

This article uses three definitions of creativity:

1. As a repertoire of knowledge and experience (de Bono, 1982), assuming that the larger the repertoire of knowledge of the individual, the greater is their creativity.
2. As a structured method of work that requires effort and dedication (Munari, 2008, 2015) – ideas do not depend only on the inspiration of the moment.
3. As a combination of old and new elements (Young, 2003).

In a world experiencing constant technological change, it is easy to find examples of scientific research that present creativity as an indispensable tool for the survival of individuals in current or future work environments (Kremer, Villamor & Aguinis, 2019): *'the complex problems of today and massive unpredictability of tomorrow require more investment and support for human creativity'* (Pugsley & Acar, 2018, p.1).

The question that arises for educators in the face of this is: 'How to develop primary science pedagogy that promotes creativity?'.

In this article we analyse the results of a workshop that we facilitated for 17 primary teachers in June 2019, where de Bono and Munari's use of children's drawings to measure creativity was replicated to evaluate their findings and consider the implications for educators.

Table 1. Inside the human body: children aged from 5 to 13 years (source: Munari *et al*, 1976).

Organ/System	Frequency	Age
Heart	Very frequent	5 +
Brain	Very frequent	6 +
Cardiovascular	Frequent	8 +
Skeleton	Least frequent	10 +
Digestive	Frequent (in and out tubes)	7 +
Lungs	Frequent (no place defined)	7 +
Bones	Frequent (scattered all over the body)	8 +

Using children's drawings to measure creativity

Inside the human body – child's version:

A team of psychologists at the University of Geneva, in partnership with Italian and Swiss teachers, performed an experiment with 600 Italian (Northern Italy) and Ticino (Switzerland) children, asking them to draw the interior of the human body (Munari, Filippini, Regazzoni & Visseur, 1976; Munari, 2015).

Our analysis of the drawings (Table 1) shows that the brain and heart were the organs that were drawn most frequently by children from the age of 6, that the circulatory system was frequently represented from the age of 8, and that, by the age of 10, the skeleton was still infrequently represented.

The typical child's drawing shows a fragmented and lacunar representation: many parts are missing, and those parts represented are disjointed. As they get older, because of the impact of school learning,

Table 2. Improving the human body: children aged from 7 to 9 years (n=16, source: de Bono, 1982).

Body part	Adding/Subtracting (n)	New part or new feature
Legs	More legs (6)	No
Heart	Two hearts (1)	No
Arms	More arms (6)	No
Eyes	More eyes (6)	No
Head	More head (1)	No
Ears	More ears (3)	No
Fingers	More fingers or different fingers (2)	No
Mouth	More or bigger mouth (6)	No
Appearance	Change quickly (1)	Yes
Nose	More noses or in another place (5)	No
Radar	One radar (1)	Yes
Feet	Feet with spiral springs	Yes

children draw in more detail and include parts that are missing from younger children's representations. However, some systems are still typically represented as black boxes, for example the digestive system, where children know where the food enters, have an idea that it is processed inside the body and comes out as faeces (most frequent child description of how the digestive system works), regardless of the child's age.

Make a more efficient human body:

Maltese psychiatrist Edward de Bono, in his book *Children Solve Problems* (1973), presents a problem posed to children aged 7, 8 and 9 years: how to make the human body more efficient. Our analysis of drawings of the improved human body from the study reveals that children usually almost entirely limit themselves to multiplying existing body parts (see Table 2).

Of 39 parts or characteristics added by children in this study (de Bono, 1982), only three were not a mere duplication or transformation of existing body parts or features, which reveals, according to the creativity criteria used in this article and based on de Bono (1982), Munari *et al* (1976), Munari (2015) and Young (2003), a low level of creativity.

Evaluating de Bono's and Munari's findings in a CPD workshop for primary teachers

We began the workshop with the following question put to 17 participating UK primary teachers: 'In your opinion, who is the most creative, children or adults?'. The answer was unanimous: 'Of course, the children are!'. No definition of creativity had been presented. A group of 72 Brazilian pre-school and primary teachers (June 2018) and a group of 83 Brazilian undergraduate students in the fields of Natural Sciences and Mathematics (July 2017) had given the same answer when questioned. When asked for a rationale, the teachers argued that children have more imagination and greater capacity for fantasy and therefore children are more creative.

We then gave the participants the following instructions:

- 'What do we have underneath the skin? Please draw the inside of the human body.'
- 'Now draw an improved human body, adding or subtracting features that increase its efficiency.'

Participants had five minutes to make their drawings. We repeatedly stressed that the drawings would not be analysed for their aesthetic component.

Our comparison of the first of the participants' drawings to the children's drawings in the Manuri study reveals that the adult ones were more complete and realistic. Many drawings included a complete skeleton and various body systems (respiratory, cardiovascular, digestive...) and organs (brain, heart, lungs, kidneys...).

Table 3. Drawings by the workshop participants: inside the human body (n=17).

Organ/System	Present (n)
Heart	Yes (12)
Brain	Yes (12)
Cardiovascular	Yes (10)
Skeleton	Yes (10)
Digestive	Yes (9)
Lungs	Yes (12)

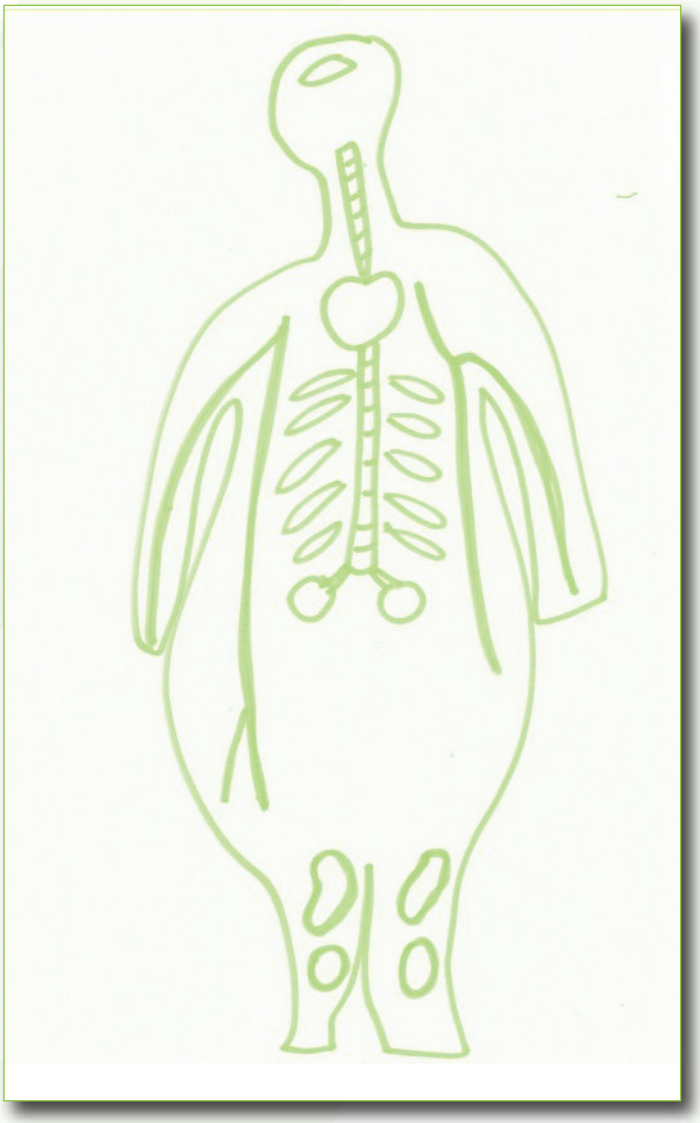
Note: The relative position of organs/systems was accurate.

After making their sketches, participants were shown Drawing 1 (Figure 1) adapted from Munari (2015) to show drawings typically made by children aged 5 to 13 years.

Although some of the participants' drawings resembled those of children, it was evident (see Table 3) that they included many more organs and systems. One participant (Figure 2) had developed an alternative representation of the human body using a mechanical model (literally the human body as a machine), with gears replacing the brain, a clock instead of the heart and a factory representing the complexity of the functioning of the body systems.

Therefore, the participants showed a broad repertoire of knowledge regarding the organs and systems inside the human body, and one showed his creativity by using a mechanical metaphor to represent the functioning of the human body.

Figure 1. Typical drawing from children aged 5 to 13 years after the instruction 'What do we have underneath the skin? Please draw the inside of the human body' (adapted from Munari, 2015 – brain, spine, heart, veins, lungs and bones, drawing by Ana Paula Bossler).

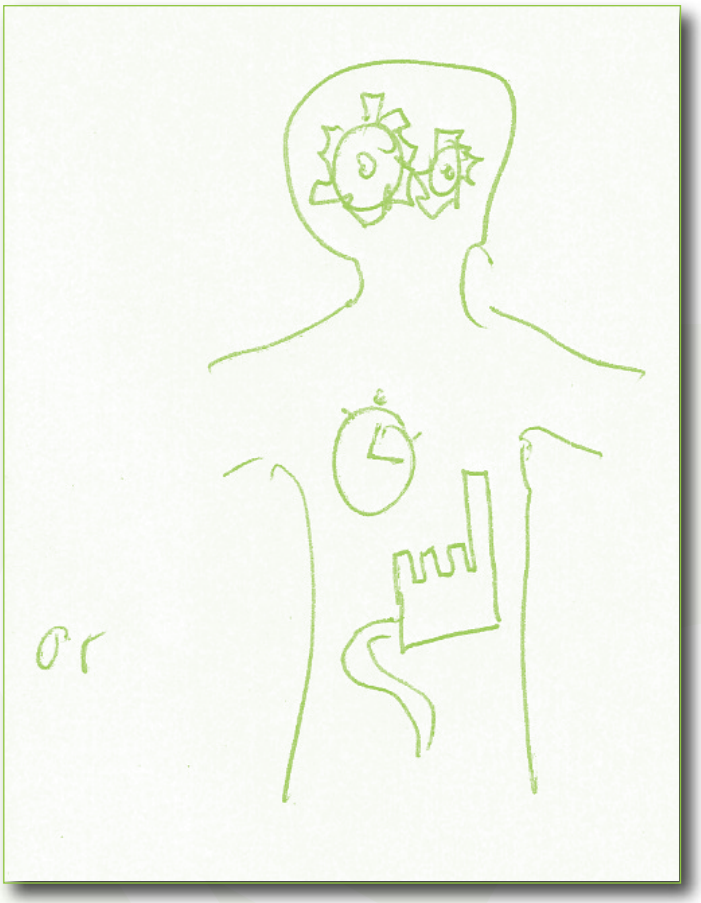


The analysis of participants' second drawings shows the inclusion of new parts and features that go far beyond the mere multiplication of body parts drawn by children in de Bono's study. Out of 12 participants who gave us their drawings for the study, five added flight-permitting parts (either by adding helicopter propellers or wings), four added gills (which allow breathing in water), and three others included X-ray vision and a further three a mind-reading mechanism (some drawings included more than one of these characteristics).

New part/feature	Present (n)
Wings or helicopter propellers	5
Gills	4
X-ray vision	3
Mind-reading mechanism	3

Table 4. Sketches by the workshop participants: a more efficient human body (n=12).

Figure 2. Alternative representation from participant.



New body parts such as wings or gills, or new features such as X-ray vision or a mind-reading mechanism, are indicators of creativity: combining two or more different pieces of unrelated knowledge in a new idea (Young, 2003).

Which drawings showed most creativity?

The workshop in Edinburgh confirmed our assumption that, when adults are asked about who is most creative, children or adults, the answer is invariably the same: children! Independent of the age, background or even national or cultural background of the participants in our *ad hoc* observations, the answer is always unanimous.

However, if Young's (2003) creativity indicator, taking two unrelated ideas to generate a completely new one, is applied to the evidence

from the workshop, it suggests that children tend to be less creative than educated adults. We argue that this is because creativity depends not only on the ability to combine ideas, but also on the individual's repertoire of ideas (knowledge and experiences). Therefore, the argument we propose is: the wider the repertoire of knowledge and experiences, the more creative is the individual.

The Munari study shows that, when children are still at the beginning stages of learning anatomy, between ages 5 and 13, they cannot list some of the body parts, nor position parts relative to one another. The adult workshop participants had already had time to consolidate their learning on the theme. Thus, it is not surprising that their drawings are much more complete, with the parts generally well positioned relative to one another. Moreover, one of these adults even managed to make a metaphorical representation of the functioning of the human body as if it were a machine: that is, the drawing brought together two ideas and created something new, something different, something creative.

However, the difference in creativity between children and adults becomes more apparent when comparing the second set of drawings from the workshop participants with those of children (de Bono, 1982). Fewer than 20% of children in that study drew creative solutions to make the human body more efficient, while, in our workshop, 70% of participants devised creative solutions to the same problem.

Discussion

The findings from our workshop indicate that children are less creative than adults when using typical school knowledge, due to the differences in their respective repertoire of knowledge and experience (Young, 2003). When comparing two groups as disparate in knowledge and experience as children between the ages of 5 and 13, and primary teachers of science, with the latter group having much broader and deeper knowledge and understanding of what is inside the human body than the first, it seems clear that adults are far more creative than children (Young, 2003), even though researchers have argued that children have a more vivid and active imagination (Munari, 2015).

Thus, it seems that an important determinant of creativity is the repertoire of knowledge and experience: the wider the repertoire, the more unrelated ideas can be used to create new ones. Adults tend to be much more creative than children, as they have a much more extensive repertoire or repository of knowledge and life experiences, due to the amount of learning, knowledge and experience accumulated throughout their lives. And this is evident when comparing educated adults (the participants in the workshop), and schoolchildren (those studied by de Bono, 1982).

Conclusion

There are roughly two ways of assessing an individual's creativity. The first is self-referenced (through questionnaires in which, for example, individuals indicate how much they consider themselves creative in different situations). The second is hetero-referenced, that is, how others consider us creative. In comparative terms, the second is more robust than the first, since self-assessment of traits in humans – intelligence, creativity, kindness and so on – is extremely flawed.

This difference between self- and hetero-assessments of creativity was used in this article in choosing the theoretical frameworks for creativity, favouring authors with solid definitions of creativity and who have developed work in professions where being creative is central to professional success, namely: someone from advertising (Young, 2003), someone from the field of industrial design (Munari, 2015) and, finally, someone whose focus over the last 50 years of his career was to support the development of creativity (de Bono, 1982).

For these three authors, creativity is determined by the accumulated amount of knowledge (Young, 2003), the ability to combine unrelated pieces of knowledge into new ideas (Young, 2003), and using structured processes that can be analysed and replicated (de Bono, 1982; Munari, 2015; Young, 2003). Thus, to identify an idea as creative, it is enough to verify that it results from two pre-existing ideas presented in an innovative format.

Using these criteria, this study found that:

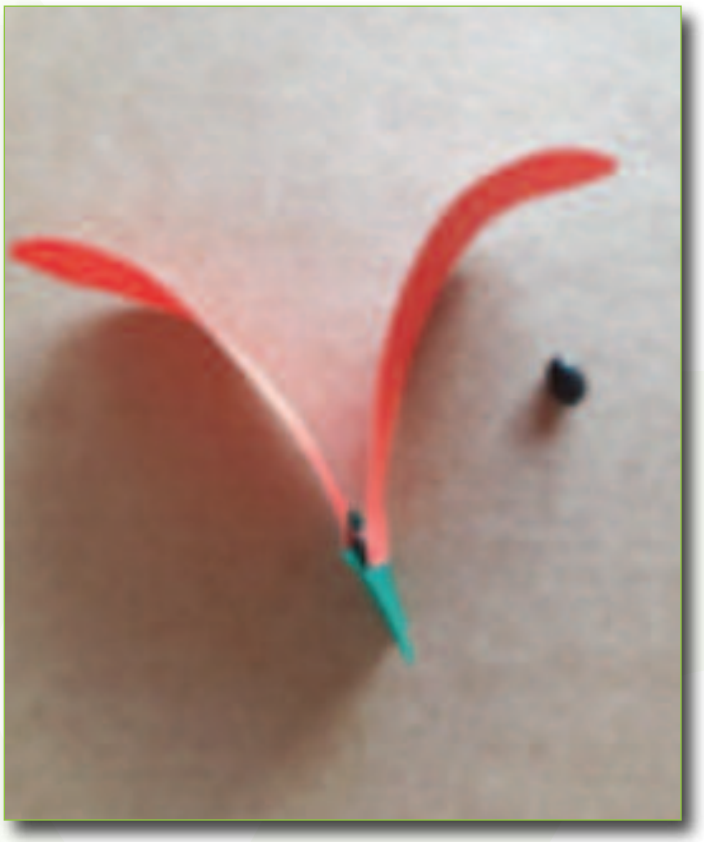
- Educated adults have a broader and more correct repertoire of knowledge relating to the human body, both with regard to body parts and systems and their relative positions, when compared to child repertoire on the same subject (Munari *et al,* 1976).
- Adults generate more ideas that are considered creative in a typical school activity when compared to children (Munari, 2015; Young, 2003).
- Broader repertoires of knowledge regarding a specific theme tend to generate more creative responses from individuals.

Since students are more creative regarding science content in school compared to out of school (Runco *et al,* 2017), the school can and should leverage science-related learning to provide students with opportunities to be not only more creative with regard to scientific knowledge, but also to all other types of knowledge related to it (e.g. arts, maths or drama).

What teachers can do to promote their pupils' creativity: expanding children's repertoire of knowledge

The creativity definitions of de Bono (1982), Munari (2015) and Young (2003), suggest that creativity involves forming new ideas by connecting pre-existing unrelated ideas, in a structured process. Thus, expanding the children's repertoire of knowledge can support creative explorations. For example, in the workshop, we presented a practical example of what teachers can do to increase their pupils' creativity related to the teaching of seed dispersal in biology (flying seeds, Figure 3). Before building their own seed wings for the beans, the children explored natural flying seeds, thus allying conceptual learning and a play-based teaching strategy *'as it involves the children in a meaningful and stimulating activity in which they participate on their own terms'* (Björklund, 2014, p.391). The children's seed wing designs are enhanced by the experience of launching a range of seeds and watching them fall. By building, reviewing and rebuilding the flying seeds, children increase their repertoire of knowledge about both seed dispersal and systematic investigation.

Figure 3. Flying seed.



Petrich *et al* (2013) listed four tentative indicators of learning when learners are involved in active learning processes such as observing seed flights: engagement, intentionality, innovation and solidarity. These kinds of behaviours can be observed when children 'play' with flying seeds in the kindergarten. These behaviours were also observed in the workshop when primary science teachers 'played' with flying seeds: when they built them, when they launched them, and when they thought collectively about the impact that a similar activity could have on their classrooms.

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