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Questão 1

O Texto 1 a seguir é um trecho da página 235 do artigo "The Role of Visual Representations in the Learning of Mathematics", de Abraham Arcavi, publicado em Educational Studies in Mathematics, vol. 52, p. 215-241, em 2003. A partir da leitura, responda às perguntas apresentadas ao final.

Texto 1

VISUALIZATION IN MATHEMATICS EDUCATION – SOME UNSEENS WE ARE BEGINNING TO 'SEE'

Nowadays, the centrality of visualization in learning and doing mathematics seems to become widely acknowledged. Visualization is no longer related to the illustrative purposes only, but is also being recognized as a key component of reasoning (deeply engaging with the conceptual and not the merely perceptual), problem solving, and even proving. Yet, there are still many issues concerning visualization in mathematics education which require careful attention.

Borrowing from Eisenberg and Dreyfus (1991), I propose to classify the difficulties around visualization into three main categories: 'cultural', cognitive and sociological.

A 'cultural' difficulty refers to the beliefs and values held about what mathematics and doing mathematics would mean, what is legitimate or acceptable, and what is not. We have briefly referred to this issue while discussing the status of visual proofs. Controversy within the mathematics community, and statements such as "this is not mathematics" (Sfard, 1998, p. 454) by its most prominent representatives, are likely to permeate through to the classroom, via curriculum materials, teacher education etc. and shape their emphasis and spirit. This attitude, which Presmeg (1997, p. 310) calls 'devaluation' of visualization, leaves little room for classroom practices to incorporate and value visualization as an integral part of doing mathematics.

Cognitive difficulties include, among other things, the discussion whose simplistic version would read as follows: is 'visual' easier or more difficult? When visualization acts upon conceptually rich images (or in Fischbein's words when there are intervening conceptual structures), the cognitive demand is certainly high. Besides, reasoning with concepts in visual settings may imply that there are not always procedurally 'safe' routines to rely on (as may be the case with more formal symbolic approaches). Consciously or unconsciously, such situations may be rejected by students (and possibly teachers as well) on the grounds of being too 'slippery', 'risky' or 'inaccurate'.

Another cognitive difficulty arises from the need to attain flexible and competent translation back and forth between visual and analytic representations of the same situation, which is at the core of understanding much of mathematics. Learning to understand and be competent in the handling of multiple representations can be a long-winded, context dependent, nonlinear and even tortuous process for students (e.g. Schoenfeld, Smith and Arcavi, 1993).

Under sociological difficulties, I would include what Eisenberg and Dreyfus (1991) consider as issues of teaching. Their analysis suggests that teaching implies a "didactical transposition" (Chevallard, 1985) which, briefly stated, means the transformation knowledge inexorably undergoes when it is adapted from its scientific/academic character to the knowledge as it is to be taught. It is claimed that this process, by its very nature, linearizes, compartmentalizes and possibly also algorithmetizes knowledge, stripping it (at least in the early stages) from many of its rich interconnections. As such, many teachers may feel that analytic representations, which are sequential in nature, seem to be more pedagogically appropriate and efficient.

Another kind of difficulty under the heading 'sociological' (or better socio-cultural), is the tendency of schools in general, and mathematics classrooms in particular, to consist of students from various cultural backgrounds. Some students may come from visually rich cultures, and therefore for them visualization may counteract possible 'deficits'. In contrast, visualizers may be under-represented amongst high mathematical achievers (Presmeg, 1986, 1989).

Pergunta 1. A categoria "cultural" é uma das citadas pelo autor na qual são apontadas dificuldades para o uso da visualização no ensino. Cite algumas das dificuldades mencionadas inerentes a essa categoria.

Pergunta 2. Como o autor apresenta em seu texto a definição de "transposição didática", referindo-se ao artigo de Chevallard?

Questão 2
O Texto 2 a seguir é um artigo publicado por Michael Shermer em 1/jan/2017 na seção Behavior & Society da revista Scientific American, disponível em https://www.scientificamerican.com/article/how-to-convince-someone-when-facts-fail/. A partir da leitura, responda às perguntas apresentadas ao final.

Texto 2

BEHAVIOR & SOCIETY

How to Convince Someone When Facts Fail

Why worldview threats undermine evidence

By Michael Shermer on January 1, 2017

Credit: Izhar Cohen

Have you ever noticed that when you present people with facts that are contrary to their deepest held beliefs they always change their minds? Me neither. In fact, people seem to double down on their beliefs in the teeth of overwhelming evidence against them. The reason is related to the worldview perceived to be under threat by the conflicting data.

Creationists, for example, dispute the evidence for evolution in fossils and DNA because they are concerned about secular forces encroaching on religious faith. Anti-vaxxers distrust big pharma and think that money corrupts medicine, which leads them to believe that vaccines cause autism despite the inconvenient truth that the one and only study claiming such a link was retracted and its lead author accused of fraud. The 9/11 truthers focus on minutiae like the melting point of steel in the World Trade Center buildings that caused their collapse because they think the government lies and conducts "false flag" operations to create a New World Order. Climate deniers study tree rings, ice cores and the ppm of greenhouse gases because they are passionate about freedom, especially that of markets and industries to operate unencumbered by restrictive government regulations. Obama birthers desperately dissected the president's long-form birth certificate in search of fraud because they believe that the nation's first African-American president is a socialist bent on destroying the country.

In these examples, proponents' deepest held worldviews were perceived to be threatened by skeptics, making facts the enemy to be slayed. This power of belief over evidence is the result of two factors: cognitive dissonance and the backfire effect. In the classic 1956 book When Prophecy Fails, psychologist Leon Festinger and his co-authors described what happened to a UFO cult when the mother ship failed to arrive at the appointed time. Instead of admitting error, "members of the group sought frantically to convince the world of their beliefs," and they made "a series of desperate attempts to erase their rankling dissonance by making prediction after prediction in the hope that one would come true." Festinger called this cognitive dissonance, or the uncomfortable tension that comes from holding two conflicting thoughts simultaneously.

Two social psychologists, Carol Tavris and Elliot Aronson (a former student of Festinger), in their 2007 book Mistakes Were Made (But Not by Me) document thousands of experiments demonstrating how people spin-doctor facts to fit preconceived beliefs to reduce dissonance. Their metaphor of the "pyramid of choice" places two individuals side by side at the apex of the pyramid and shows how quickly they diverge and end up at the bottom opposite corners of the base as they each stake out a position to defend.

In a series of experiments by Dartmouth College professor Brendan Nyhan and University of Exeter professor Jason Reifler, the researchers identify a related factor they call the backfire effect "in which corrections actually increase misperceptions among the group in question." Why? "Because it threatens their worldview or self-concept." For example, subjects were given fake newspaper articles that confirmed widespread misconceptions, such as that there were weapons of mass destruction in Iraq. When subjects were then given a corrective article that WMD were never found, liberals who opposed the war accepted the new article and rejected the old, whereas conservatives who supported the war did the opposite ... and more: they reported being even more convinced there were WMD after the correction, arguing that this only proved that Saddam Hussein hid or destroyed them. In fact, Nyhan and Reifler note, among many conservatives "the belief that Iraq possessed WMD immediately before the U.S. invasion persisted long after the Bush administration itself concluded otherwise."

If corrective facts only make matters worse, what can we do to convince people of the error of their beliefs? From my experience, **1.** keep emotions out of the exchange, **2.** discuss, don't attack (no ad hominem and no ad Hitlerum), **3.** listen carefully and try to articulate the other position accurately, **4.** show respect, **5.** acknowledge that you understand why someone might hold that opinion, and **6.** try to show how changing facts does not necessarily mean changing worldviews. These strategies may not always work to change people's minds, but now that the nation has just been put through a political fact-check wringer, they may help reduce unnecessary divisiveness.

Pergunta 3. Uma das explicações para que algumas pessoas continuem defendendo suas crenças a despeito de evidências é a chamada "dissonância cognitiva". Dê um exemplo.

Pergunta 4. Segundo o autor, o que podemos fazer para convencer as pessoas dos equívocos de suas crenças?

Questão 3

O Texto 3 a seguir é um trecho (pág. 16) do artigo "Conceptual Profiles: Theoretical-methodological Grounds and Empirical Studies, de C. N. El-Hani, E. M. R. Amaral, C. Sepulveda e E. F. Mortimer, publicado na revista Procedia – Social and Behavioral Sciences, vol. 167, pág. 15-22, em 2015. Leia o texto e forneça uma versão (uma tradução em formato livre) em português do seu conteúdo.

Texto 3

1. Introduction

The idea of a conceptual profile, namely, that people can exhibit different ways of seeing and representing the world, used in different contexts, was proposed in the 1990s (Mortimer, 1995), initially inspired by Bachelard's epistemological profile. It was framed as an alternative to the claim in theories and models of conceptual change (such as Posner and colleagues', 1982) that science learning involved breaking away from everyday knowledge, students' previous concepts, and worldview tenets. The underlying idea is that verbal thinking is heterogeneous and, thus, word meanings are often polysemous, both in science and in everyday language. In subsequent developments, conceptual profiles were integrated into a theoretical framework treating science learning as learning the social language of school science through classroom discursive interactions, analyzed from a sociocultural perspective (Mortimer & Scott, 2003). In this framework, the following theories are integrated into a synthesis made coherent by several shared assumptions, characteristic of sociocultural approaches: conceptual profiles, as tools for analyzing modes of thinking; the theory of language of the Bakhtin circle, as a basis for analyzing ways of speaking; Vygotsky's theory of the development of higher mental functions, as a basis for investigating learning; Mortimer and Scott's framework for research into classroom communicative approaches.

Conceptual profiles are models of different modes of seeing and conceptualizing the world used by individuals to signify their experience (Mortimer & El-Hani, 2014). In any classroom there is inevitable heterogeneity in modes of thinking and talking. In order to build a theory about teaching and learning, which allows us to intervene in classroom dynamics in an informed manner, we need to model this heterogeneity of speech and thought.

In conceptual profile theory the problem of generating new meanings in science teaching is framed in terms of the interplay between modes of thinking and ways of speaking, considering the coexistence in the individual of two or more meanings for the same word or concept, accessed in the appropriate contexts. This coexistence is possible even within scientific concepts, in which the dissonance between classical and modern views of the same phenomena is a norm, not an exception.