



MINISTÉRIO DA EDUCAÇÃO
UNIVERSIDADE FEDERAL DO PIAUÍ – EDITAL 20/2017

Realização:



EXAME DE PROFICIÊNCIA DE LEITURA EM LÍNGUA ESTRANGEIRA

DATA: 14/01/2018

HORÁRIO: das 8 às 11 horas

CADERNO DE PROVA

Idioma:

INGLÊS

Área de Pesquisa:

(2) CIÊNCIAS EXATAS E DA TERRA, ENGENHARIAS

LEIA ATENTAMENTE AS INSTRUÇÕES

- Esta prova é constituída de um texto técnico-científico em língua estrangeira, seguido de 5 (cinco) questões abertas relativas ao texto apresentado.
- É permitido o uso de dicionário impresso, sendo vedados trocas ou empréstimos de materiais durante a realização do Exame.
- As respostas deverão ser redigidas em português e transcritas para a **Folha de Respostas**, utilizando caneta esferográfica com **tinta preta** ou **azul, escrita grossa**.
- A Folha de Respostas** será o único documento válido para correção, não devendo, portanto, conter rasuras.
- Será eliminado o candidato que se identificar em outro espaço além daquele reservado na capa da **Folha de Respostas** e/ou redigir as respostas com lápis grafite (ou lapiseira).
- Nenhum candidato poderá entregar o Caderno de Prova e a Folha de Respostas antes de transcorridos 60 minutos do início do Exame.
- Em nenhuma hipótese haverá substituição da **Folha de Respostas**.
- Ao encerrar a prova, o candidato entregará, obrigatoriamente, ao fiscal da sala, o Caderno de Prova e a Folha de Respostas devidamente assinada no espaço reservado para esse fim.

Fractions: Where It All Goes Wrong

Why do Americans have such trouble with fractions—and what can be done?

By Robert S. Siegler on November 28, 2017

Many children never master fractions. When asked whether $12/13 + 7/8$ was closest to 1, 2, 19, or 21, only 24% of a nationally representative sample of more than 20,000 US 8th graders answered correctly. This test was given almost 40 years ago, which gave Hugo Lortie-Forgues and me hope that the work of innumerable teachers, mathematics coaches, researchers, and government commissions had made a positive difference. Our hopes were dashed by the data, though; we found that in all of those years, accuracy on the same problem improved only from 24% to 27% correct.

Such difficulties are not limited to fraction estimation problems nor do they end in 8th grade. On standard fraction addition, subtraction, multiplication, and division problems with equal denominators (e.g., $3/5+4/5$) and unequal denominators (e.g., $3/5+2/3$), 6th and 8th graders tend to answer correctly only about 50% of items. Studies of community college students have revealed similarly poor fraction arithmetic performance. Children in the US do much worse on such problems than their peers in European countries, such as Belgium and Germany, and in Asian countries such as China and Korea.

This weak knowledge is especially unfortunate because fractions are foundational to many more advanced areas of mathematics and science. Fifth graders' fraction knowledge predicts high school students' algebra learning and overall math achievement, even after controlling for whole number knowledge, the students' IQ, and their families' education and income. On the reference sheets for recent high school AP tests in chemistry and physics, fractions were part of more than half of the formulas. In a recent survey of 2300 white collar, blue collar, and service workers, more than two-thirds indicated that they used fractions in their work. Moreover, in a nationally representative sample of 1,000 Algebra 1 teachers in the US, most rated as "poor" their students' knowledge of fractions and rated fractions as the second greatest impediment to their students mastering algebra (second only to "word problems").

Why are fractions so difficult to understand? A major reason is that learning fractions requires overcoming two types of difficulty: inherent and culturally contingent. Inherent sources of difficulty are those that derive from the nature of fractions, ones that confront all learners in all places. One inherent difficulty is the notation used to express fractions. Understanding the relation a/b is more difficult than understanding the simple quantity a , regardless of the culture or time period in which a child lives. Another inherent difficulty involves the complex relations between fraction arithmetic and whole number arithmetic. For example, multiplying fractions involves applying the whole number operation independently to the numerator and the denominator (e.g., $3/7 * 2/7 = (3*2)/(7*7) = 6/49$), but doing the same leads to wrong answers on fraction addition (e.g., $3/7 + 2/7 \neq 5/14$). A third inherent source of difficulty is complex conceptual relations among different fraction arithmetic operations, at least using standard algorithms. Why do we need equal denominators to add and subtract fractions but not to multiply and divide them? Why do we invert and multiply to solve fraction division problems, and why do we invert the fraction in the denominator rather than the one in the numerator? These inherent sources of difficulty make understanding fraction arithmetic challenging for all students.

Culturally contingent sources of difficulty, in contrast, can mitigate or exacerbate the inherent challenges of learning fractions. Teacher understanding is one culturally-contingent variable: When asked to explain the meaning of fraction division problems, few US teachers can provide any explanation, whereas the large majority of Chinese teachers provide at least one good explanation. Language is another culturally-contingent factor; East Asian languages express fractions such as $3/4$ as "out of four, three," which makes it easier to understand their meaning than relatively opaque terms such as "three fourth." A third such variable is textbooks. Despite division being the most difficult operation to understand, US textbooks present far fewer problems with fraction division than fraction multiplication; the opposite is true in Chinese and Korean textbooks. Probably most fundamental are cultural attitudes: Math learning is viewed as crucial throughout East Asia, but US attitudes about its importance are far more variable.

Given the importance of fractions in and out of school, the extensive evidence that many children and adults do not understand them, and the inherent difficulty of the topic, what is to be done? Considering culturally contingent factors points to several potentially useful steps. Inculcating a deeper understanding of fractions among teachers will likely help them to teach more effectively. Explaining the meaning of fractions to students using clear language (for example, explaining that $3/4$ means 3 of the $1/4$ units), and requesting textbook writers to include more challenging problems are other promising strategies. Addressing inherent sources of difficulty in fraction arithmetic, in particular understanding of fraction magnitudes, can also make a large difference.

Fraction Face-off!, a 12-week program designed by Lynn Fuchs to help children from low-income backgrounds improve their fraction knowledge, seems especially promising. The program teaches children about fraction magnitudes through tasks such as comparing and ordering fraction magnitudes and locating fractions on number lines. After participating in Fraction Face-off!, fourth graders' fraction addition and subtraction accuracy consistently exceeds of children receiving the standard classroom curriculum. This finding was especially striking because Fraction Face-off! devoted less time to explicit instruction in fraction arithmetic procedures than did the standard curriculum. Similarly encouraging findings have been found for other interventions that emphasize the importance of fraction magnitudes. Such programs may help children learn fraction arithmetic by encouraging them to note that answers such as $1/3+1/2 = 2/5$ cannot be right, because the sum is less than one of the numbers being added, and therefore to try procedures that generate more plausible answers. These innovative curricula seem well worth testing on a wider basis.

