DIFFERENT WAYS OF EXPRESSING RELATIVE FREQUENCIES NUMERICALLY AND THE STRUGGLE OF CONVERTING THEM

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Relative frequencies can be represented using percentages (e.g., 25%); common fractions (e.g., 1/4); decimal fractions (e.g., 0.25); natural frequencies (e.g., 1 out of 4); the "notation with every" (e.g., "every fourth"); or odds (e.g., 1 to 3) (Gigerenzer & Hoffrage, 1995; Krauss et al., 2020). At first, these different representations seem cognitively easy to understand, but how do students really perform when, for example their mutual conversion is required?

In an empirical study, $N = 79$ German students from grade 6 and 7 participated. Every student had to answer four questions. In the first (closed) multiple answer item (e.g., "What does 40% mean?"), the students had to decide which of seven given possible conversions were right or which were wrong (e.g., A: "4 out of 10," B: "every fortieth," C: "2/5," D: "one fortieth," etc.). The remaining three (open) items each required students to actively convert one concrete notation of a relative frequency into others (e.g., "Please convert 'every fourth' into the according percentage and natural frequency.").

Results show that students greatly struggle when converting one notation into another. Although students on average could only identify 61% of the given alternatives in the first item correctly, the performance with the three open items was worse. Students actively converted only 25% correctly. Furthermore, we were able to identify typical errors. A first noticeable mistake was that the students did not recognize the difference between "out of" in natural frequencies and "to" in odds (e.g., they wrote 3 out of 4 = 3 to 4). A second conspicuous error occurred in converting relative frequencies to the form of with "every." The students often used numbers they saw (e.g., four in "every fourth") in their answers, although this was not the correct conversion (e.g., every fourth = 4 % or 40 %).

Because students struggle with the conversion of relative frequency notations, an implementation of this competence into school curricula considering the typical errors is needed. We propose the introduction to the different ways of expressing relative frequencies in a systematic approach oriented towards the basic concepts of natural frequencies (Wiesner et al., in press). In this approach, the explicit new conversions to be learned are reduced by always choosing a path via the natural frequencies. Thus, instead of 30 conversions, only three reciprocal conversion principles must be taught.

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