Supplemental Digital Appendix 1

Procedure for Correcting for Attrition and Study Duration in This Reanalysis of Curriculum Comparison Studies Involving Dutch Medical Schools

The differences in knowledge development of students attending two different medical schools that use different types of curricula can be investigated using the students' scores on a jointly administered progress test that is taken by the students of both schools. As medical knowledge is expected to increase for each increasing curricular year, between-school comparisons are made per (curricular) year group (1–6 in a Dutch medical school's curriculum). When the abilities of the students entering each school are similar, and the graduation rate (*GR*) and time needed to graduate (*TG*) are also similar, comparing the average scores per year group may reveal the success of the different curricula with regard to their students' development of medical knowledge. Conversely, a low *GR* (i.e., a high drop-out rate) is expected to inflate a school's average score because, generally, the least able students have dropped out. A short *TG* is expected to deflate a school's average score because the students on average have had less time to develop their knowledge.

In this study, we assessed the success of problem-based learning (PBL) and conventional curricula regarding Dutch students' development of medical knowledge on the basis of test results obtained with a jointly administered progress test. The majority of data in curriculum comparison studies that provide progress test results are only available now in the form of mean (*M*) and standard deviation (*SD*) per year group for each school. If, in addition, data on *GR* and

TG are also available for the compared schools, *M* (and *SD*) of the scores can be corrected for differences in *GR* and *TG*, thus enabling a fair comparison between schools.

Correction of *M* and *SD* for *GR* and *TG*

Data structure: [$T0(i)$, $M0(i)$ and $SD0(i)$], and [$T1(i)$,$M1(i)$ and $SD1(i)$], $i = 1, 2, \ldots, 6$, where $T0$, $M0$, $SD0$, and $T1$, $M1$, $SD1$ represent measurement time, mean, and standard deviation of the progress test scores for students at the problem-based and the conventional school, respectively, and index i indicates the measurement number.

For the initial data index i refers to the (curriculum) year group and measurement time is measured in years, hence, $T0(i) = T1(i) = i$.

Furthermore, it is assumed that for both schools data are available on graduation rate and time needed to graduate: [$GR0$, $TG0$], and [$GR1$, $TG1$], respectively.

The correction is conducted in two steps:

1. Correction for differences in graduation rate (*GR*), followed by
2. Correction for differences in time needed to graduate (*TG*).

For the second step, we have to distinguish between two situations:

a. Time needed to graduate is shorter for the problem-based school: $c = TG1/TG0>1$

b. Time needed to graduate is longer for the problem-based school: $c = TG1/TG0<1$

Step 1

In the Dutch medical curricula, the major part of student attrition is concentrated at the end of the first curriculum year. Hence, it is reasonable to assume in the analysis that all attrition is concentrated at the end of the first year. To correct for *GR* differences, therefore, data are removed from the lower part of the score distribution (the weaker students). For all combinations of PBL and conventional curricula investigated in the present study it holds: $GR0>GR1$. Accordingly, the correction is obtained by removing a fraction $100*(GR0-GR1)/GR0$ from the lower part of the score distribution of school 0, the problem-based school. Assuming the scores have a Gaussian distribution, a sample of 1,000 random cases for a standard normal distribution is generated and sorted. Removal of the above fraction from the lower part of the distribution and calculation of *M* and *SD* for the resulting distribution results in correction coefficients *Delmean* and *DelSD*. Then, the corrected values $M0'(i)$ and $SD0'(i)$ can be calculated according to:

$$M0'(i) = M0(i) + Delmean \times SD0(i);\quad SD0'(i) = DelSD \times SD0(i);\; i=2,...,6$$

Step 2a: *c*>1

In this step, the data of the problem-based school remain unchanged while the conventional school's curve is stretched in the horizontal direction to represent the longer time needed to graduate at the conventional school. Accordingly, the corrected measurement time for the conventional school, $T1'(i)$, is defined:

$$T1'(i) = c \times T1(i);\; i=1,...,6;\;\; \text{where } c = TG1/TG0$$

Then by interpolation (respective extrapolation) for the measurement times *i* on the problem-based school's curve, the corresponding score $M1'(i)$ on the stretched conventional school curve is obtained according to:

$$M1'(1) = M1(1) + [1 - T'(1)] \times [M1(2) - M1(1)] / c; \quad i = 1$$
$$M1'(i) = M1(i-1) + [i - T'(i-1)] \times [M1(i) - M1(i-1)] / c; \quad i = 2,.., 6$$

Step 2b: *c*<1

In this step, the data of the problem-based school remain unchanged and the conventional school's curve is stretched, as in Step 2a, using the same formula for *T*1'(i). Then the new scores *M*1'(i) on the stretched conventional school curve can be obtained according to:

$$M1'(i) = M1(i) + [i - T'(i)] \times [M1(i+1) - M1(i)] / c; \quad i = 1,.., 5$$
$$M1'(6) = M1(6) + [6 - T'(6)] \times [M1(6) - M1(5)] / c; \quad i = 6$$

The *SD* of the stretched curve, *SD*1'(*i*) could be obtained similar to *M*1'(*i*) by inter- and extrapolation of the original data. However, as the *SD* often does not show a substantial trend, the interpolations and extrapolations would be unreliable. Therefore, we decided to copy the *SD* values from the original measurement points. Hence, for the new measurement points *T*1'(*i*) of the conventional school, *SD*1'(*i*)—the *SD* of the new curve—is defined

$$SD1'(i) = SD1(i); \; i=1,...,6$$