To the full report

Evaluation of the Foundation's Portfolio of Mathematics Tasks as Aligned with the PISA Conceptual Framework

Abstract based on a detailed analysis by Zbigniew Marciniak and Agnieszka Sułowska

Beginning in 2018, the foundation approached research and development centers in Israel for the purpose of developing mathematics learning tasks that correspond to the PISA conceptual framework at the high levels (5-6). Over the course of four years, 500 such tasks were developed through 25 different programs — each addressing different perspectives and contexts of applied mathematics. The objective of this review was to examine the degree to which these tasks align with the PISA conceptual framework. The analysis was led by Prof. Zbigniew Marciniak, a mathematician and a former Polish education deputy minister who also served as the chair of the PISA assessment's mathematics expert group.

Main findings

1. Tasks were examined based on several criteria derived from the PISA assessment: level of mathematical reasoning and argumentation, the real-world context, mathematics level, range of mathematics topics, opportunities for learning, and didactic opportunities and challenges.

2. The tasks found to be the most aligned with the PISA 5-6 standards are those which were developed by the University of Haifa (MAOF), those developed by the Weizmann Institute of Science (Mahalachim and Think Far), and those developed by the Technion (Machshava) and Think.org.il (Practimatics).

3. Comments made with respect to other programs mostly pertained to tasks which were too closed-ended and led students to the solution, those with a low a level of mathematical reasoning and argumentation, or those which had errors. It was found that the level of the curriculum for distance learning, mostly in Arabic speaking schools did not meet the PISA assessment standards.

4. Tasks developed within a scientific context (chemistry, physics, biology, and computer sciences) naturally stress the scientific field. But it was found that they were not sufficiently explicit in their mathematical indices and were not integrated at a high enough level.

5. In summary, about half of the tasks examined encourage mathematical reasoning and argumentation. There is another 10% of tasks whose correspondence to PISA can be enhanced without much effort. The researchers recommend integrating the opportunity for mathematical reasoning and argumentation in each and every task.

6. Only about half of the tasks encourage joint thinking processes, class research and discussion, and a similar proportion deepen mathematical skills. The researchers recommend that the developers abandon the classical textbook tasks model and develop more challenging and open-ended tasks.

7. The way mathematics is integrated in science tasks does not enable deep understanding of mathematics and can produce misconceptions. In such cases, the researchers recommend explicitly presenting the mathematical concepts and tools.

8. The tasks dealing with geometry are those which, in the researchers' opinion, summon the best opportunities for developing reasoning and argumentation thinking and skills. The researchers recommend that the developers increase the weight and scope of geometry tasks.