Teaching Mathematics Through Problem Solving for Low-Readiness Learners

Ban Heng Choy
National Institute of Education, Nanyang Technological University
banheng.choy@nie.edu.sg

Despite the consensus on the importance of problem solving in school mathematics, it is not always clear whether problem solving should be the "end result" or "means through which mathematical concepts, processes, and procedures are learnt" (Lester, 2013, p. 246). Common approaches, or what Lester (2013) referred to as an "ends approach" (p. 246), to feature problem solving in classrooms include creating a series of specialized lessons to teach problem solving (Toh et al., 2016) and using problems positioned at the end of each chapter in textbooks as opportunities for students to apply their newly learned concepts to more novel problems (Jäder et al., 2019). One important merit of this approach is the explicit emphasis of the four-phase problem-solving model of George Pólya—understanding the problem, devising a solution plan, carrying out the plan, and looking back at the solution (Pólya, 1945). Such an approach provides a clearer guideline for students to follow instead of leaving it for them to grapple with the problem. However, providing students with clearly articulated steps to follow may hinder students' development of problem solving skills and dispositions (Goulet-Lyle et al., 2019). For instance, in Singapore, teachers often demonstrate a step-by-step approach to solving problems for their students, especially for those who are struggling with mathematics or low readiness students (Kaur et al., 2019). Moreover, textbooks often present problem solving as following a solution template, which is not helpful (Jäder et al., 2019). Therefore, while providing students a step-by-step approach to problem solving may reduce the complexity of the problem-solving tasks and hence offer them more access to these problems; students are consequently denied of the opportunity to make sense of the mathematics and less likely to persist in problem solving when they encounter new problems. In this short communication, I will share the initial ideas of a new project, aimed at teaching mathematics through problem solving, and invite feedback from participants on the type of problems and they are used in the classrooms to teach mathematics.

References

Goulet-Lyle, M.-P., Voyer, D., & Verschaffel, L. (2019). How does imposing a step-by-step solution method impact students' approach to mathematical word problem solving? *ZDM*, *52*(1), 139–149. https://doi.org/10.1007/s11858-019-01098-w

Jäder, J., Lithner, J., & Sidenvall, J. (2019). Mathematical problem solving in textbooks from twelve countries. *International Journal of Mathematical Education in Science and Technology*, *51*(7), 1120–1136. https://doi.org/10.1080/0020739x.2019.1656826

Kaur, B., Toh, T. L., Lee, N. H., Leong, Y. H., Cheng, L. P., Ng, K. E. D., Yeo, K. K., Yeo, B. W. J., Wong, L. F., Tong, C. L., Toh, W. Y. K., & Safii, L. (2019). *Twelve questions on mathematics teaching*. National Institute of Education, Nanyang Technological University.

Lester, F. K. J. (2013). Thoughts about research on mathematical problem-solving instruction. *The Mathematics Enthusiast*, *10*(1 & 2), 245–278.

Pólya, G. (1945). *How to solve it*. Princeton University Press.

Toh, T. L., Tay, E. G., Leong, Y. H., Quek, K. S., Toh, P. C., Dindyal, J., Ho, F. H., Kang, K. H., & Yen, Y. P. (2016). *Mathematical problem solving for everyone: Infusion and diffusion (MinD).* NIE Research Brief Series (Issue No. 16–011). National Institute of Education.

(2023). In B. Reid-O'Connor, E. Prieto-Rodriguez, K. Holmes, & A. Hughes (Eds.), *Weaving mathematics education research from all perspectives*. *Proceedings of the 45th annual conference of the Mathematics Education Research Group of Australasia* (p. 574). Newcastle: MERGA.