Feature Article

Great Reads: On the Value of Delays in Teaching

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ABSTRACT: Sometimes a great read resolves perplexities. This brief article involves two perplexities: Why would high-quality instruction not be associated with student learning gains on pre- and post-tests? How could a first-semester prospective teacher succeed where a veteran teacher failed in helping students understand certain concepts? Both are explained by the findings of a recent meta-analysis article about when, not how, mathematics instruction occurs.

KEYWORDS: Instruction; Research-to-Practice; Problem Solving

Sometimes research can seem separated from realistic practice, but at other times it can bring sharp clarity to matters of practice. A few years ago, we learned of such a research finding that resolved two perplexities for us. One perplexity was that, when studying 47 Midwestern mathematics classes (Otten et al., 2023), we documented several strong features of teachers' instruction but could not detect a positive relationship between those features and students' learning. We were mystified that whole-class teaching with conceptual development, justifications, integrated representations, student contributions to the mathematical discourse, etc., did not correlate with students' procedural or conceptual gains on pre/post-measures. Why were these features of "good teaching" not associated with positive learning outcomes? The other perplexity arose within secondary teacher preparation. We both teach instructional methods courses and one day the prospective teachers were talking in groups about their field placements. Samuel overheard one say that her field placement was going well. She was assisting in a local school (not yet lead teaching) and she interacted with students during their work time. The prospective teacher described

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how students often got confused and called her over, and after she helped them, they finally understood. This led her to make the statement that perplexed us: “I think I’m better than the host teacher!” We were glad to see her confidence but dubious that this prospective teacher in her first instructional methods course could actually explain concepts more effectively than the host teacher.

These seemingly-unrelated events confounded us for months, until we read a meta-analysis by Sinha and Kapur (2021) involving research from mathematics and science education. Sinha and Kapur (2021), instead of engaging in the longtime debate of teacher-led instruction versus student-led problem solving, examined the sequencing of instruction and problem solving. Which is more effective, instruction followed by problem solving (I→PS) or problem solving followed by instruction (PS→I)? Their meta-analysis combined 50+ studies (mostly of mathematics instruction but also some science instruction, at various levels) and they computed the general relationship between those two sequences (I→PS, PS→I) and students’ procedural and conceptual learning.

For elementary grades, the two sequences I→PS and PS→I had similar effects, but there was a difference at the secondary level where PS→I had a large positive effect on conceptual learning (approximately +0.5 standard deviations relative to I→PS, which is extremely noteworthy in educational research). To be clear, PS→I does not mean full discovery-oriented teaching; PS→I just means students have an opportunity to try problems or gather their initial thoughts before the teacher explains or demonstrates it. Sinha and Kapur (2021) describe how having PS first, even if only for a few moments, allows students to activate their relevant prior knowledge and become curious about the lesson content so they are ready, even grateful, when the teacher provides instruction. We add that starting with PS, where the student’s responsibility is just to try, not to be correct or complete, sets a safer and less judgmental culture than does I→PS (because if a teacher has already provided instruction, then there is an implicit, or sometimes explicit, expectation placed upon students that they should now be able to complete the work successfully).

With this meta-analysis finding in hand, we can now resolve our two perplexities. With those 47 diverse mathematics classes, it is not enough to look at how “good” the teaching was, we also have to look at when the teaching occurred within the lesson. Although many teachers enacted high-quality instruction, nearly all of them did so before they gave the students a chance to try the day’s problems. These teachers missed the advantage of the +0.5 effect size for conceptual learning that could come from having students try a bit of problem solving first, before instruction. This, of course, is not the sole explanation for the observed phenomenon, but it is a plausible one.

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As for the precocious prospective teacher, it is not that she is necessarily "better" than her host teacher, she simply had the advantage of timing. The host teacher likely explained things at the start of the lesson, but the prospective teacher could swoop in after students had tried some problems and so were receptive to her explanations. Those "a ha!" moments are more likely to happen after students have engaged with the material—that is, when the instruction follows problem solving (Figure 1).

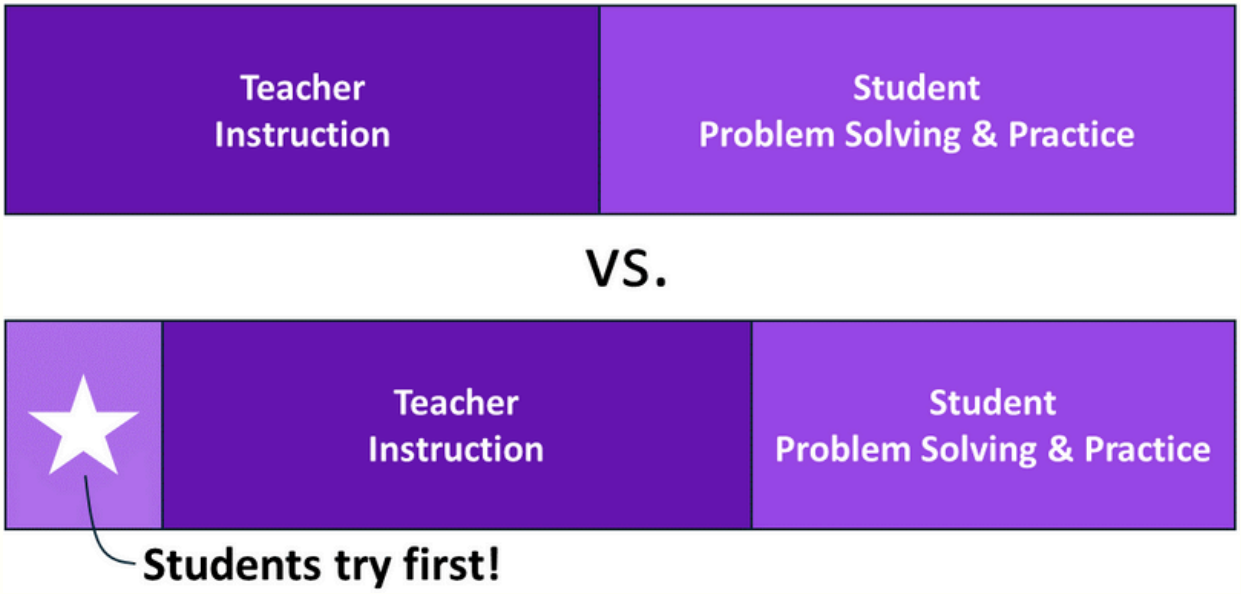

Figure 1. Advice about the timing of teaching within a lesson (Practice-Driven Professional Development, 2024), based on Sinha and Kapur's (2021) meta-analysis.

Having learned from Sinha and Kapur (2021) of the positive PS→I effect, we now view it as somewhat of a tragedy when a teacher gives high-quality instruction but does it at the start of the class period. There are a few ways we as teachers can avoid this tragedy. We can, for instance, delay our initial worked example and instead pose that first problem to students. Then, when we proceed with instruction, we should make connections to students' attempts, whether correct, incorrect, or incomplete. Another option is to use warm-up problems not as a review but as a true warm-up for the day's key idea. It could be a problem students do not yet know how to solve but which will be explained in the lesson. Again, they do not have to solve it fully, the prompt could be for them to generate possible first steps or identify what makes this problem different from prior problems.

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Overall, we hope this brief note brings more attention to the Sinha and Kapur (2021) meta-analysis and might spur further consideration of modest but meaningful adjustments in classroom instruction, not altering the material teachers are presenting but optimizing its placement.

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