

Math Counts: Issues That Matter

A PROFESSIONAL SERIES, VOLUME 4

THE ROLE OF PRACTICE IN MASTERING MATHEMATICS



“Performance in mathematics and practice are inextricably linked—students who use effective practice sets increase their level of mathematical understanding and performance.”

Practice is a fundamental part of any mathematics curriculum. Well-developed practice sets support daily instruction while also reinforcing and refreshing previously learned concepts and skills. Practice sets in textbooks should be designed so students apply their concepts and skills in a variety of contexts to ensure a strong understanding of the uses of each.

Additionally, these practice sets need to be concise with emphasis given to the most recent topic of instruction. Textbooks that are sequential in nature inherently aid students in maintaining many skills. This occurs because students use their previously learned skills as a base for more advanced skills. Effective practice sets offer a variety of problems in small sets that emphasize

the most recent material. Performance in mathematics and practice are inextricably linked—students who use effective practice sets increase their level of mathematical understanding and performance. When practice is well designed, it “improves the speed and accuracy of performance” for all students (Ericsson).

Practice Guidelines

Practice is an essential extension of classroom instruction that is used for students to reinforce skills and concepts taught in class. For students to *know mathematics* they need time to work with skills and procedures. Practice is the ideal time for students to test their knowledge and discover questions or ideas about the work they are doing. For practice to be fruitful for all students, accommodations may need to be made for different students. Some students may work best alone, inclusion students may need an extremely

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basic set of practice while advanced learners may benefit from working primarily on the challenge problems. Research has shown that “the maximum level of performance for individuals in [mathematics] is not attained automatically...but the level of performance can be increased...as a result of deliberate efforts to improve” (Ericsson). In order for students to improve, teachers need to provide varied practice that helps them increase their performance rather than frustrate or bore students.

Types of Practice

Guided practice immediately following instruction is essential for students to ensure they understand the content of the lesson and know the skills and procedures just presented. Guided practice sets that are short and

focus on the lesson content are most effective for students. During guided practice, teachers can work with students to help them identify their errors and correct them before independent practice. Guided practice ensures that

students “have a conceptual understanding of the problem before they are given extensive practice on the associated procedures” (California Framework).

Try It Subtract (use the hundred chart).

$67 - 30 = 37$ $40 - 20 = \underline{\quad}$ $70 - 10 = \underline{\quad}$

$82 - 30 = \underline{\quad}$ $95 - 40 = \underline{\quad}$ $60 - 30 = \underline{\quad}$ $83 - 20 = \underline{\quad}$ $20 - 10 = \underline{\quad}$ $32 - 10 = \underline{\quad}$



Subtract. Write your answer in simplest form.

$\frac{1}{2} - \frac{1}{4} = \frac{2}{4} - \frac{1}{4} = \frac{1}{4}$ $\frac{3}{4} - \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$ $\frac{5}{8} - \frac{1}{8} = \frac{4}{8} = \frac{1}{2}$ $\frac{7}{8} - \frac{3}{8} = \frac{4}{8} = \frac{1}{2}$ $\frac{9}{10} - \frac{4}{10} = \frac{5}{10} = \frac{1}{2}$

$\frac{1}{3} - \frac{1}{6} = \frac{2}{6} - \frac{1}{6} = \frac{1}{6}$ $\frac{2}{3} - \frac{1}{6} = \frac{4}{6} - \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$ $\frac{5}{6} - \frac{1}{6} = \frac{4}{6} = \frac{2}{3}$ $\frac{7}{6} - \frac{1}{6} = \frac{6}{6} = 1$ $\frac{8}{6} - \frac{2}{6} = \frac{6}{6} = 1$

In addition to straightforward exercises, a key question that gets at the heart of the lesson can sum up student understanding of the lesson. These

questions can be answered verbally or in writing and give teachers a tool for quickly assessing students' understandings of the topic at hand.



Compare and contrast adding mixed numbers with like and unlike denominators.

After guided instruction and instruction by the teacher to clarify any misconceptions, independent practice and extra practice sets allow students to apply the skills they have learned during daily instruction sessions and develop their use of these skills and

understanding of mathematical concepts. Often, practice is misconstrued as students solving the same type of problem repeatedly—the more the better. Instead, practice needs to include small sets of a variety of problems.



“For mastery of math skills to occur, students must revisit, build upon, and practice previously learned skills.”

This type of error serves as a sign to a teacher that the student does not understand regrouping and is rote subtracting the larger number from the smaller number. By offering a variety of problems (mixing addition and subtraction, regrouping and non-regrouping, perimeter and area) students have an opportunity to understand mathematical procedures and learn when and how to apply each one. Studies have demonstrated that procedural understanding improves performance in mathematics more than merely rote memorization of procedures (e.g. Higgins and Liberman).

Problem solving applications are also important parts of daily practice sets. The problem solving exercises should focus on the particular concept or skill of the lesson so students can simultaneously build on both problem solving skills and lesson content. Further, in

lessons that are dedicated to teaching problem solving skills and strategies, mixed problem solving review is essential. A mixed strategy review gives each student the opportunity to decide on his or her own what strategy to use to correctly solve the problem.

A daily, spiral review of previously learned skills and procedures is also beneficial for students. Spiral review sets need to have an equal mix of recently learned material and older, yet relevant, material. For mastery of math skills to occur, students must revisit, build upon, and practice previously learned skills. After students master a topic, the topic need not be set aside as ‘done.’ Instead, students can briefly revisit previous topics to reinforce and maintains these topics. “Expert performance is acquired slowly over a ...long time as a result of practice” (Ericsson). Spiral reviews help students

“Variety in practice builds student flexibility in solving problems and prevents only rote use of skills.”

Small sets are effective because studies have shown that humans learn most effectively in the early portion of practice session and that it truly is quality of practice not the quantity of practice that matters (Delaney). A variety of problems is vital because variety in practice builds student flexibility in solving problems and prevents only rote use of skills. Students who continually solve the same type of problem tend to use the procedure they have practiced most, without considering if it is the correct procedure to use. A common example of this is in subtraction when students always subtract the smaller number from the larger number.

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-4

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to maintain their skills, especially as students move up through the grades and have a broader range of skills to maintain.

More extensive spiral reviews that focus on the five major math strands are valuable ways to check student progress on all key math strands. When such practice is organized by strand, students become proficient

with the types of problems in each strand and teachers can more readily monitor progress. In addition, spiral reviews that are presented in standardized test format serve the second purpose of familiarizing students with test taking formats.

Some students who understand the topics get incorrect answers on tests

because the test question formats are unfamiliar. By practicing with a variety of formats, students become familiar with the different ways questions are asked on tests and gain confidence in analyzing and interpreting unfamiliar formats.

Chapter study guides are a valuable way for students to review the key concepts

of the entire chapter. Students derive the most benefit from a chapter study guide when it models each key concept for students to use to refresh their understanding of the concept. The chapter study guide can also be used as a quick review of key concepts prior to standardized tests. By having an example modeled, students are able to tutor themselves on various content areas.

Summary

Carefully designed practice sets in math textbooks need to reflect the lesson content and ensure that students have enough knowledge to complete the variety of problems. Practice should “take into account the preexisting knowledge of the learners so that the task can be correctly understood” (Ericsson). Students in elementary math classes may use practice time to enhance

and hone the skills and procedures they have learned in class. This does not mean that every type of problem in a practice set needs to be modeled for students, rather the problems are solvable for students who have an understanding of the mathematical skills and procedures needed for the problem.

Consistent attention to carefully

planned practice is an essential part of any mathematics program. Practice should always promote student understanding of mathematical skills and procedures by offering problems that require student understanding of skills and procedures, not merely rote actions. To further increase the benefits of practice, teachers need to take an active role to inform students of their goals and provide them with feedback on practice that helps them improve to performance. “The effect of practice on performance is larger than earlier believed possible” (Ericsson). Practice is not to be casually given in a mathematics classroom; rather practice needs to be a well-designed natural extension of instruction that works to positively impact student performance.



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