Three-level approach to scaffolding can be applied to teaching math

Scaffolding, or the practice of supporting learning as students gradually become more secure in their understanding, has had a major impact on how educators teach across many disciplines.

In a recent issue of the *Journal of Mathematics Teacher Education*, Julia Anghileri outlines a 3-level hierarchy of scaffolding practices for mathematics.

“Much of the background research on scaffolding has been drawn from studies that do not relate specifically to the mathematics classroom,” Anghileri writes.

“The intention is to build on existing studies and to identify classroom practices that relate to mathematics teaching,” she says.

History of scaffolding

Twenty-five years ago, researchers D. Wood, J. Bruner and G. Ross introduced the concept of scaffolding in the *Journal of Child Psychology and Psychiatry*. The authors identified scaffolding practices such as recruiting the student’s interest, prodding (keeping the learner in pursuit of an objective), pointing out discrepancies, responding to the student’s emotional state, modeling the solution, etc.

Anghileri proposes a 3-level hierarchy of scaffolding practices that specifically support mathematics learning:

- **Level 1**: Environmental provisions (classroom organization, artifacts such as blocks)
- **Level 2**: Explaining, reviewing and restructuring
- **Level 3**: Developing conceptual thinking

Learning environment a bridge

Before interacting with students, teachers scaffold learning by the environment they create in their classrooms, Anghileri says. Wall displays, puzzles, tools are some obvious examples of environmental provisions. Seating arrangements and grouping arrangements also organize the environment and can support learning, Anghileri says. Tasks that include self-correcting elements as well as computer programs are other Level 1 practices that support students’ independent learning.

Anghileri includes emotive feedback as a Level 1 scaffolding practice. By interjecting remarks, the educator can encourage and give approval to student activities. Along with organizing people and structuring work, approval and encouragement constitute the majority of interactions classified as actual scaffolds, according to one researcher (Bliss, 1996).

Reviewing and restructuring
Showing, telling and explaining continue to dominate classroom teaching, Anghileri says, but these practices can constrain student learning, she adds. Important alternatives for mathematics teachers, more in keeping with the scaffolding approach, are reviewing and restructuring. Reviewing and restructuring involve helping students develop their own understanding of mathematics, she notes.

When students are engaged with a task, Anghileri says, they are not always able to identify the most pertinent aspects of mathematical ideas or problems. In reviewing, teachers can refocus students’ attention and help them reach their own understanding. There are 5 types of reviewing interactions, Anghileri says:

- asking students to look, touch and verbalize what they see and think
- asking students to explain and justify
- interpreting students’ actions and comments
- prompting students and asking them probing questions
- parallel modeling

In parallel modeling, the teacher creates and solves a task that shares some of the characteristics of the student’s problem. “The student retains ownership of the original task but has the opportunity to see a parallel task being solved and to transfer understanding,” Anghileri says.

Examples of Restructuring

In restructuring, the teacher goes beyond consolidating students’ understanding to make ideas more accessible and take meanings forward. Some examples of restructuring include:

- providing meaningful contexts to abstract situations
- simplifying the problem
- rephrasing students’ comments
- negotiating meanings

In negotiating meanings, a teacher pays close attention to what pupils are saying and helps contribute “spoken formulations and revisions” that will arrive at a stable expression that all participants can agree with. Teachers may sometimes be concerned that incorrect meanings will be spread among students, but research has shown that learning improves when errors and misconceptions are exposed and discussed, Anghileri says.

“It is through a struggle for shared meaning that a process of cooperatively figuring things out determines what can be said and understood by both teacher and students and this is what constitutes real mathematics learning in the classroom,” Anghileri says.

Developing conceptual thinking

In mathematics, beyond solving isolated problems, students should be developing concepts through generalization, extrapolation and abstraction. At the highest level of scaffolding are the following practices, Anghileri says:

- developing representational tools;
- making connections; and
- generating conceptual discourse.
An example of representational tools is using a set of dominoes to represent a complete set, she says. Another is evoking images familiar to children, such as recognizing that a triangular prism is a “roof” shape. Graphs and spreadsheets also serve as representational tools, Anghileri says, and so do teachers notations on students’ solutions. Students use these notes to reflect on their mathematical activity.

Making connections is another crucial strategy to support mathematics learning, the author says. Different versions of the same calculation (e.g. \(\frac{1}{2} \times 40; 40 \times 0.5, 50\% \text{ of } 40\)) may help students make connections between fractions and percentages, for example.

With conceptual discourse, the teacher goes beyond explanations, Anghileri says. For example, after finding a shape that rolls, one teacher asked, “Why will it roll?” and the ensuing discussion included many observations about the concept of curved surfaces.

**Finding a Balance in Teaching Methods**

In mathematics learning, norms and standards for acceptable mathematical explanation are important characteristics of classroom discourse, she says.

“While accepting a wide range of students’ explanations, teachers can indicate thinking strategies that are particularly valued, thus enabling students to become aware of more sophisticated forms of mathematical reason,” Anghileri says. “Teachers play a vital role in shaping this discourse through signals they send about the knowledge and ways of thinking and knowing that are valued.”

Anghileri concludes that one problem with the notion of scaffolding is that it assumes learning is hierarchical and built on firm foundations, although many teachers know that elements of understanding can appear in students in an eclectic and erratic fashion. What is needed, she says, is for scaffolding to be imagined as a more dynamic and flexible process.

Sources:
https://www.ernweb.com/educational-research-articles/three-level-approach-to-scaffolding-can-be-applied-to-teaching-math/