

Lessons Learned from *Looking Inside the Classroom*

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Horizon Research, Inc. (HRI) of Chapel Hill, North Carolina, conducted a two-year national study of K–12 mathematics and science education in the United States through funding from the National Science Foundation. The study entitled *Looking Inside the Classroom* provided the education research and policy communities with snapshots of mathematics and science education as they exist in classrooms in various contexts in the United States (Weiss et al. 2003). To examine the state of teaching inside the classroom, trained consultants observed 364 mathematics and science lessons from 40 school districts. A statistical method called systematic sampling with implicit stratification was used to obtain school districts as representative of the nation as possible. For each school district in the study, a math and a science consultant observed two classes each at the elementary, middle and secondary levels. In addition to classroom observations, data collection included individual teacher interviews. (Note: Although the study evaluated mathematics and science education, this article focuses on the mathematics portion.)

As a consultant for this study, I received extensive training in the processes used to determine effectiveness of mathematics instruction. Through hours of watching classroom videos, recording field notes and practising scoring, I learned to use the classroom observation and teacher–interview protocols. I debated with my peers about the interpretation of the lessons we observed and our differences in the levels of rating the quality of the classroom instruction. We continued watching classroom videos and teacher interviews for two days until our ratings were consistent, and we were trained in writing thorough and accurate reports. Throughout this training process and the actual data collection in the schools, I contemplated the complex art of teaching and all the factors that influence our decisions in trying to meet each student’s needs. I found it extremely valuable as an educator to be exposed to a comprehensive set of guidelines suggesting multiple components that combine together to constitute effective instruction.

Components of Effective Mathematics Instruction

Information gathered from classroom observations and teacher interviews was used to assess each lesson’s effectiveness. Lesson quality was determined by assessing four main components: the lesson design, lesson implementation, the mathematical content being addressed and the classroom culture. Key indicators for lesson design included careful planning and organization, tasks consistent with investigative mathematics, attention to students’ prior knowledge and preparedness, a collaborative approach to learning among students, attention to issues of equity and diversity, and adequate time for sense-making and wrap-up. Lesson implementation was rated on instructional strategies used and the teacher’s confidence, classroom-management style, pace of the lesson, questioning strategies and ability to gauge the students’ level of understanding. The mathematical content was judged on significance, appropriateness for the students’ developmental level, accuracy of teacher-provided content, students’ intellectual engagement, and connections to other areas and/or real-world contexts. Classroom culture was rated on a climate of respect for students’ ideas, collegial working relationships, intellectual rigour, constructive criticism, challenging of ideas and the encouragement of active participation by all.

Lesson activities were timed to determine the amount of time spent on instructional activities versus housekeeping items, interruptions and other noninstructional activities. The amount of time spent in whole-class instruction, pairs or small groups, and individual work was also tracked. Each lesson was also judged on the likely impact of instruction on the students’ self-confidence, understanding of the content, interest in mathematics, ability to generalize skills to other areas and capacity to carry out their own inquiries.

Scores in all of these areas combined were used to determine the overall capsule rating, ranging from ineffective to exemplary instruction. Table 1 contains a detailed explanation of the rating scale.

Table 1
Lesson Quality Ratings

(Source: *Looking Inside the Classroom*, Appendix A, page 13)

Level 1: Ineffective Instruction

There is little or no evidence of student thinking or engagement with important ideas of mathematics/science. Instruction is highly unlikely to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science. Lesson was characterized by either

- a. **Passive Learning:** Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher or textbook; material is presented in a way that is inaccessible to many of the students.
- b. **Activity for Activity's Sake:** Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.

Level 2: Elements of Effective Instruction

Instruction contains some elements of effective practice, but there are serious problems in the design, implementation, content and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing and so on. Overall, the lesson is very limited in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Level 3: Beginning Stages of Effective Instruction

Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are weaknesses, ranging from substantial to fairly minor, in the design, implementation or content of instruction. For example, the teacher may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is somewhat limited in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Level 4: Accomplished, Effective Instruction

Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (for example, investigations, teacher presentations, discussions with each other or the teacher, or reading). The lesson is well designed and the teacher implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is quite likely to enhance most students' understanding of the discipline and develop their capacity to successfully do mathematics/science.

Level 5: Exemplary Instruction

Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work (for example, investigation, teacher presentations, discussions with each other or the teacher, or reading). The lesson is well designed and artfully implemented, with flexibility and responsiveness to students' needs and interests. Instruction is highly likely to enhance most students' understanding of the discipline and to develop their capacity to successfully do mathematics/science.

Findings

Table 2 shows a breakdown of the percentage of mathematics lessons within the K–5, 6–8 and 9–12 grade bands for each of the five capsule ratings, plus a column showing percentages for Grades K–12 combined. Overall, 60 per cent of the observed mathematics lessons received low-quality capsule ratings of 1 or 2, and only 9 per cent were rated as high-quality effective/exemplary instruction. Capsule ratings of lessons in Grades K–5 classrooms were slightly better than those in the 6–8 or 9–12 grade levels.

Mathematics lessons in the United States were found to be relatively strong in several areas. A majority of the observed lessons incorporated content that was both significant and worthwhile and had teachers who provided accurate content information and appeared confident in their ability to teach mathematics. However, fewer than 20 per cent of the mathematics lessons were strong in intellectual rigour, included effective teacher questioning strategies or provided sense-making appropriate for the needs of the students and the purposes of the lesson.

The factors that seemed to distinguish effective lessons from ineffective ones were their ability to

- engage students with the mathematics content;
- create an environment conducive to learning;
- ensure access for all students;
- use questioning to monitor and promote understanding; and
- help students make sense of the mathematics content. (Weiss et al. 2003)

With the release of the *Principles and Standards for School Mathematics* (NCTM 2000) at the time the study began, it was surprising that only 1 per cent of the

Table 2
Percentage of Mathematics Lessons by Capsule Rating and Grade Level

(Source: *Looking Inside the Classroom*, pages C24, D24, E24)

Capsule Ratings Level	K–5 6–8 9–12 K–12 Per Cent			
	1: Ineffective Instruction	18	26	39
2: Elements of Effective Instruction	27	38	30	32
3: Beginning Stages of Effective Instruction	43	25	26	31
4: Accomplished, Effective Instruction	8	11	5	8
5: Exemplary Instruction	4	0	0	1

teachers in this study mentioned national standards as having an influence on the selection of the content for their lessons. None of the teachers attributed the selection of their instructional strategies to the national standards. Given the current emphasis on national standards, this was an unexpected finding.

A Challenge for All Mathematics Teachers

My personal motto has always been to engage all students in meaningful mathematics. As we continue learning and growing in our quest to become better teachers, I hope that we will thoughtfully consider the effectiveness of our mathematics lessons. Perhaps it would be helpful for each of us to read the capsule rating descriptions in Table 1 while thinking of a recent lesson we taught and determine where we currently are on the rating scale. I find it most helpful to concentrate on the aspects of exemplary instruction:

- Purposeful instruction
- Highly engaged students
- Meaningful work (for example, investigation, teacher presentations, discussions or reading)
- Well-designed and artfully implemented lessons
- Flexibility and responsiveness to students' needs and interests
- Instruction that is highly likely to enhance most students' understanding of the discipline and to develop their capacity to successfully do mathematics/science

Through self-reflection and an understanding of the components and key indicators of quality instruction, we can choose from a variety of areas to work on for improvement.

Based on findings from the *Looking Inside the Classroom*, the United States is very far from the ideal of providing high quality mathematics instruction for all students. Teachers need a vision of what effective instruction is in K–12 mathematics. With this understanding, they need to critically compare a variety of lessons with the key elements of high-quality instruction.

For a full report of the study and the classroom observation and teacher interview protocols, go to www.horizon-research.com/insidetheclassroom.

References

- National Council of Teachers of Mathematics (NCTM). *Principles and Standards for School Mathematics*. Reston, Va.: Author, 2000.
- Weiss, I. R., et al. *Looking Inside the Classroom: A Study of K–12 Mathematics and Science Education in the United States*. Chapel Hill, N.C.: Horizon Research, Inc., 2003.