Formative Assessment and Science Notebooks

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The Question:

"Will responding to science notebooks using formative assessment that includes student participation result in significant improvement of reasoning strategies and communication skills?"

Steve predicted the investment of time and emphasis on student participation would result in significant improvement ... on a rubric of process skills.

The Process:

A group of fourth-grade students completed a pre-assessment, took part in four science investigations, and completed a post-assessment. These students used science notebooks throughout the process. Steve explains:

> When students engage in science inquiry and use science notebooks, they demonstrate a variety of process skills. These skills include forming testable questions, observing and exploring materials, and planning and carrying out an orderly investigation to answer their question. Finally, they interpret the results of their investigation in light of their ideas and communicate those ideas clearly.
>
> Each of these investigations stages offers opportunity for the teacher to assess. The practice of science-notebook skills is fundamental to each stage.

In the beginning, students found the work very challenging and needed significant help with basic science skills. For example, his students had a great deal of difficulty using data tables to organize their research, analyze and communicate results.

As Steve notes:

> Early difficulties in Communication and Use of Data Skills (one of the Exemplars assessment criteria) stemmed from students not recognizing the value of using data tables. Students were not used to creating data tables as an aid to mapping out investigation strategies, remembering to take all observations, displaying evidence and making predictions.

As a result,

> the data from the first investigations consisted entirely of hurried writing with numerous unrelated details. Students busily wrote down scattered observations without attempting to collect them in a logical or coherent order. They often made up conclusions as if out of thin air. They did not make the higher-level connection between random observations and organized data.

To help his students move to the desired level, Steve developed poorly designed data tables to

> allow students to discover the advantages of well-designed data tables. After they worked with the data tables, students began to see data not as tedious, but as valuable evidence. Once students grasped the organization of tables, they were used enthusiastically.

Formative assessment was an active part of the instructional process in Steve's classroom.

As part of the formative assessment process, students became active peer assessors. In the beginning, students had trouble developing testable questions, or—after the inquiry was completed—developing good questions for further study. Steve notes,

> In the early stages of assessment, students demonstrated limited understanding of Reasoning and Procedure Skills. They did not provide evidence of investigation and planning strategies. They struggled to construct a testable question. Students had little trouble with the idea of forming further questions at the end of the investigation, but they had trouble forming something reasonable and not flippant.

To assess their testable questions and post-study follow-up questions, the queries had to pass the scrutiny of classmates involved in the study. The question asked was, "Will this stand up in court?" The strategy of opening up questions to scrutiny from other students made students justify their questions.

Student self-assessment was also an important part of the process. In addition to a student rubric, there was a "So Where Do We Go From Here? Improvement Contract." The contract included a student's summary of "strengths" and "weaknesses" discussed and a Plan for Improvement. Steve explains:

> Once students were familiar with the self-assessment and contract practice, they responded enthusiastically to goal-setting. They reacted with confidence to the self-assessment rubric, identifying goals and sharing in the improvement contract. More assertive students argued the validity of their improvement evidence.

> Students took the initiative to paste the contract forms in their science notebooks. During an investigation I noticed students glancing back to the improvement form to note previous skill weaknesses to address.

Did it all make a difference in student performance?

Steve concludes:

> The results of my research question, "Will responding to science notebooks using formative assessment that includes student participation result in significant improvement of reasoning strategies and communication skills?" were confirmed.

Results:

Five students were involved in the study. After completing the four investigations, students were again assessed using two criteria: Scientific Reasoning and Procedures and Scientific Communication/Using Data. On the pre-assessment, no students met the standard, that is, achieved at least at the Practitioner level, on either criterion. After the completion of the instructional tasks four students met the standard on Reasoning and Procedures and on the Communication criteria.

Reasoning and Procedures

	Pre-Test	Post-Test
Novice	2	
Apprentice	3	1
Practitioner		4
Expert		

Communication

	Pre-Test	Post-Test
Novice	3	
Apprentice	2	1
Practitioner		3
Expert		1

On Reasoning and Procedures, four of five students showed progress. Two students who were at the Novice level moved to Practitioner. Of the three students who were at the Apprentice level, two moved to Practitioner and one student remained at Apprentice.

On Communication, all students showed progress. Of the three students at the Novice level, one moved to Apprentice and two to Practitioner. Of the two students who started at Apprentice, one became a Practitioner and the other an Expert.

Steve found that Exemplars served him well in the study, both as an instructional and assessment tool. He noted, "The Exemplars series on math, writing and science is based on the practice of formative assessment with student partnership and has produced a working framework that puts these readily into practice."

> I used the Science Exemplars program because it provided well-designed materials and teacher guidance for implementation. Science Exemplars emphasized short experiments rich in content and process skills with detailed materials and guidance for developing student self-assessment. The program provided examples of student work from notebooks as portable document (PDF) sheets. The teacher had easy reference to notated assessments of each page for consistent rubric scoring.

The use of the Science Exemplars program made it possible to give concise, consistent notebook ratings. Science Exemplars made it easy to set up a reliable and effective formative assessment program for science notebooks. It would be difficult for a school district to assemble the research, create the materials and organize a program to do this. Science Exemplars provided a teacher guidebook for inquiry science investigations that was focused on careful implementation.