Looking Into Students’ Science Notebooks: What Do Teachers Do With Them?

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Outline

- The importance of looking into instructional activities
- Students' notebooks as a source of information of the instructional activities
- Characteristics of the students' notebook entries
- Conclusions
On Instructional Activities

Effective instructional activities should:

• Have a clear connection with the learning goals

• Provide students with opportunities to better understand the content and to apply what they have learned

• Provide evidence about learning for two receivers, from students to teacher and to students themselves
Instructional Activity Demands

• Level of students’ thinking is influenced by the demands of the activities they are asked to do.

• Activities that are more demanding will enable students to process information deeper and more meaningfully than less demanding activities.
Students’ Notebooks as a Source of Information

**Science Notebooks:**

- Are a written account of what students do in their science class, and possibly, of what they learn
- Should reflect to some degree the characteristics of the instructional activities in which students were involved
- Should reflect to some degree if teachers use them as a source of information about students’ progress
Students’ Science Notebooks

4/5/97 Mixtures and Solutions

Solutions are the substances that are made when something you put into a mixture does not settle out. 

Mixtures: Mixtures are a solution with one major ingredient such as the cake mixture.

Examples: Gravel
Powder (diatomaceous earth)
Salt (sodium chloride)

Separating Mixtures

1. Label three cups. Put one level spoon (5 ml spoon) of each solid material in its cup. Observe the three solid materials. Fill in the property chart below.

<table>
<thead>
<tr>
<th></th>
<th>Color</th>
<th>Texture</th>
<th>Particle shape</th>
<th>Particle size</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td></td>
<td></td>
<td>Sand</td>
<td>About 1 cm</td>
<td>grain</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powder</td>
<td></td>
<td></td>
<td>Gravel, chalk</td>
<td>About 0.5 cm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td></td>
<td></td>
<td>Gravel, salt</td>
<td>About 0.1 cm</td>
<td></td>
</tr>
</tbody>
</table>

4/9/97 Mixture: two or more materials put together.

Examples: Milk and cereal
Butter and toast
Liquids: sand and water
Tacos, burritos, hamburgers
Peanut butter and jelly

Mixtures can always be taken apart.

The mixture that can be completely separated with the screen is gravel. The powder can be separated with a filter.

Solution: a special kind of mixture; if the solid material in a mixture can’t be separated from the water with a filter, it is a solution.

Salt disappears or dissolves in water to make a salt water solution.

Will done ~

Emily! Great job identifying mixtures and solutions!
Students’ Notebooks as an *Immediate* and *Unobtrusive* Assessment Tool

**Notebooks:**

- Allow to collect information on *students’ performance* and *opportunity to learn*

- Are a source of evidence at two levels:
  - *individual level* – provide information on student’s performance over a course of instruction
  - *classroom level* – provide information on the type of instructional activities and the quality of teacher feedback
How Are Students’ Notebooks Used as an Assessment Source?

Each notebook entry is:

• Linked to the content of the unit

• Classified and coded according to type (e.g., description of a procedure) and characteristics (e.g., copied?)

• Scored for quality of the communication according to scientific genres

• Scored for student’s understanding

• Scored for the quality of teacher feedback if one is found
Types of Entries

Defining
Exemplifying
Applying Concepts
Predicting/Hypothesizing
Reporting Results
Interpreting Results/Concluding
Reporting, Interpreting/Concluding
Reporting Procedures
Reporting Experiments
Designing Experiments
Content Questions/Short Answer
Quick Writes
Assessments
Don’t Care Activities

- **Recounts**
  * Use of verbs in past tense
  * Communication refers to specific people or events (e.g., Today we put together…)

- **Directions**
  * Use of simple present tense
  * Use of a generalized actor, usually “you”—“you put…,” “you get…”

- **Instructions**
  * Use of imperative clauses (e.g., Put…)
  * Participants and events in the communication are general not specific
Coding the Entries

• Characteristics of the experiments carried out
  – Replications? More than one level of the independent variable? Both?

• Format of the entry
  – Provided by curriculum developers? By teachers? By the students?

• General Characteristics of the entry
  – Supplemental picture or graph? Repeated entry? Copied definitions?
**Notebook Scoring**

<table>
<thead>
<tr>
<th>Unit Implementation</th>
<th>Student Performance</th>
<th>Teacher Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>What instructional activities were implemented as reflected in the students’ journals?</td>
<td>Were students’ communications appropriate to the characteristics of the written genre at hand?</td>
<td>Did the teacher provide helpful feedback on students’ performance?</td>
</tr>
<tr>
<td>Were other appropriate additional activities implemented?</td>
<td>Did students’ communications indicate conceptual understanding?</td>
<td>Did the teacher encourage students to improve the quality of their communications?</td>
</tr>
</tbody>
</table>
## Quality of Scientific Communication

<table>
<thead>
<tr>
<th>Score</th>
<th>Quality of Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Incoherent and not understandable communication</td>
</tr>
<tr>
<td>1</td>
<td>Understandable but not using the characteristics of the genre</td>
</tr>
<tr>
<td>2</td>
<td>Understandable and uses <em>some</em> of the basic characteristics of the genre</td>
</tr>
<tr>
<td>3</td>
<td>Understandable and uses <em>all</em> the basic characteristics of the genre</td>
</tr>
</tbody>
</table>
The Study

• **Participants**: Eight elementary schools and 10 classrooms in a medium-sized urban school district in the Bay Area

• **General Design**: Notebooks were collected for two science units at the end of the year

### FOSS UNITS

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>Mixtures</td>
</tr>
</tbody>
</table>
The Study

Selection of Notebooks:

• Teachers ranked students based on their performance level

• Six students’ notebooks per classroom were randomly selected based on teachers’ ranking: two top, two middle, and two low

• A total of 120 students’ notebooks (1,804 pages) were scored, 60 for Variables and 60 for Mixtures
Results

We examined:

• Whether raters could consistently classify and code notebooks entries, score students’ performance, and teacher feedback

• The nature of the notebook entries

• The relation between quality of entries and students’ learning
<table>
<thead>
<tr>
<th>Type of Score</th>
<th>Variables</th>
<th>Mixtures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Implementation</td>
<td>0.99</td>
<td>0.99</td>
</tr>
<tr>
<td>Student Performance</td>
<td>0.85</td>
<td>0.84</td>
</tr>
<tr>
<td>Teacher Feedback</td>
<td>0.86</td>
<td>0.91</td>
</tr>
<tr>
<td>Type of Entry Agreement</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>85.47%</td>
</tr>
</tbody>
</table>
Type of Entries More Frequently Found: Focusing on Understanding Concepts

- Defining
- Exemplifying
- Applying Concepts

Variables
Mixtures
Type of Entries More Frequently Found: Focusing on Process Skills

- Predicting
- Results
- Interpreting
- Res and Inter
- Procedures
- Experiments
- Designing

Percentage

Type of Entry

Variables
Mixtures
Type of Entries More Frequently Found: Others

![Bar chart showing the percentage distribution of type of entries: Short Ques, Quick Writes, Assessments. The chart highlights that Short Ques have the highest percentage, followed by Quick Writes and then Assessments.]
Looking Closely!

• Seventy percent of the Definitions found across the notebooks were copied!

• Most of the Procedures reported were in the form of a narrative (recount). Most of them were not replicable!

• Only four percent of the Experiments reported involved replications!
Type of Entry and Students’ Performance

- Students were administered an end-of-unit performance assessment before and after each unit:
  - Variables Unit: Pendulum Assessment
  - Mixtures Unit: Saturated Solutions
- Based on the magnitude of the effect size we classified classrooms as with top, medium, or low improvement
Relation Between Type of Entry and Students’ Performance

<table>
<thead>
<tr>
<th>Type of Entry</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining</td>
<td>Top: 25</td>
</tr>
<tr>
<td></td>
<td>Medium: 20</td>
</tr>
<tr>
<td></td>
<td>Low: 15</td>
</tr>
<tr>
<td>Exemplifying</td>
<td>Top: 18</td>
</tr>
<tr>
<td></td>
<td>Medium: 8</td>
</tr>
<tr>
<td></td>
<td>Low: 5</td>
</tr>
<tr>
<td>Applying Concepts</td>
<td>Top: 4</td>
</tr>
<tr>
<td></td>
<td>Medium: 2</td>
</tr>
<tr>
<td></td>
<td>Low: 1</td>
</tr>
<tr>
<td>PASSENGER</td>
<td>#</td>
</tr>
<tr>
<td>-----------</td>
<td>---</td>
</tr>
<tr>
<td>1 passenger</td>
<td>7</td>
</tr>
<tr>
<td>5 passengers</td>
<td>85</td>
</tr>
<tr>
<td>7</td>
<td>90</td>
</tr>
<tr>
<td>10</td>
<td>95</td>
</tr>
<tr>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>
Nature of Teachers’ Feedback

The bar chart shows the percentage of feedback types categorized as "Inconsistent", "-2", "-1", "0", "1", "2", and "3" for both "Variables" and "Mixtures". The chart indicates that feedback is mostly concentrated around the "1" category, with a significant peak for "Variable" feedback, while "Mixtures" feedback is less frequent across all categories.

Key:
- Yellow: Variables
- Blue: Mixtures
Conclusions

• Students’ science notebooks can provide partial information about the nature of the instructional activities in which students are involved.

• Low student performance scores revealed that students’ communication skills and understanding were far away from the maximum score and did not improve over the course of instruction during the school year.

• A partial explanation may be that the demands of the tasks required by the teachers were in general, low. These types of tasks by themselves can hardly help students to improve their understanding and performance.

• There is a lot of room for professional development programs.
Did students improve their performance?

– Bottom Line: **NO!**

– Worse, in some classes students did better at the beginning of year than at end. Difference was significant! **Ugh!!!!!**
Definitions: Looking Closely!

![Bar chart showing percentage of copied and not copied variables and mixtures.](chart.png)
Reporting Procedures: Looking Closely!

The bar chart shows the percentage of variables and mixtures in the recount, directions, and instructions categories. The recount category has the highest percentage for variables, while the instructions category has the highest percentage for mixtures.