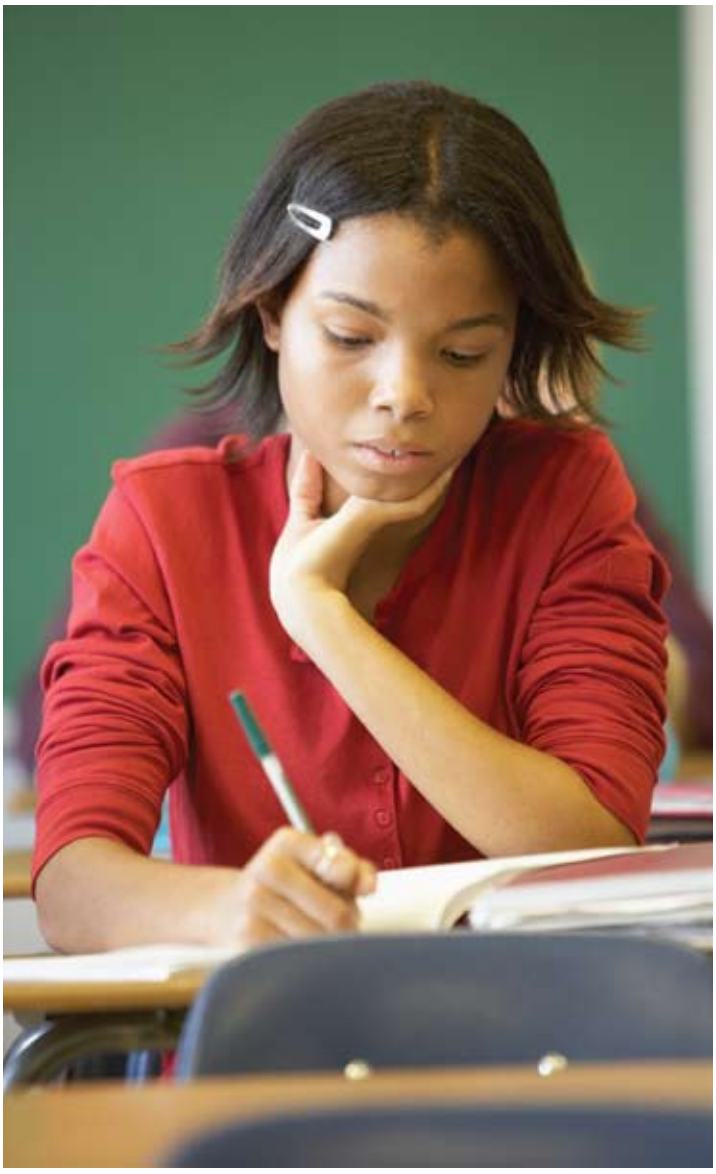


Integrating Interactive Notebooks

A daily learning cycle to empower students for science

—Cheryl Waldman and Kent J. Crippen—

An interactive notebook can be a powerful instructional tool, allowing students to take control of their learning while processing information and engaging in self-reflection. The three-part learning cycle of an interactive notebook makes it easy to use and integrate into the science lesson. The basic idea has its roots in a number of programs (TCI 2000; AVID 2007), but applying knowledge about how students learn science can make this an even more effective tool.

At its best, an interactive notebook provides a varied set of strategies to create a personal, organized, and documented learning record. In addition to presenting techniques for design, implementation, and assessment, this article describes how interactive notebooks empower students for science achievement.

Design

Based upon the flow of information between teachers and students in a science lesson, the interactive notebook is composed of three types of activities. *In* activities provide a scaffold for class discussion by activating prior knowledge and motivating students immediately as they come into the classroom. *Through* activities allow the teacher to direct student learning from a fragmented conceptual knowledge to understanding. *Out* activities emphasize reflection on key concepts at the end of the lesson, before students go out of the classroom. The *in, through,* and *out* activities provide a daily rhythm of learning. *In* and *out* activities are prompted student responses; *through* activities are provided by the teacher.

Each class period begins with students completing an *in* activity that reviews a concept from the previous class, introduces the topic of the day, or probes their prior knowledge related to the topic at hand. Based on their own understanding and creativity, students direct this activity as they respond to teacher prompts or questions—resulting in an output of information. *In* activities take about 5 minutes to complete and can be done alone or in small groups. While circulating around the room, the teacher quickly provides individualized feedback and uses the activity to prompt discussion for the lesson to follow.

The daily lesson constitutes the *through* activity. This can include conducting lecture or discussion, engaging in a laboratory procedure, or viewing a film or documentary during class—all of which are initiated and directed by the teacher. In *through* activities, objective information (course concepts) is provided to students—resulting in an input of information.

An *out* activity occurs at the end of class. It closes the day's lesson with an emphasis on reviewing key concepts, using deliberate practice, or drawing connections among ideas. Like *in* activities, *out* activities are teacher-initiated, but student-directed. Teachers provide the prompts, but students produce the answers, diagrams, and so on—allowing them to reflect on their own learning.

Individual student work created from participating in the *in* and *out* activities is mapped onto the left page of a standard spiral-bound notebook; *through* activities are placed on the right-hand page. Students quickly become familiar with this daily learning cycle and come to expect it each class (Figure 1). However, the cycle can be modified for extended projects or laboratory activities. Color and highlighting are used throughout the notebook to emphasize and reinforce learning. Students are expected to use color to emphasize main concepts and vocabulary, to indicate levels of questions they write, and to distinguish details of diagrams and concept maps.

The power of an interactive notebook lies in the *in* and *out* activities, while the *through* activity functions primarily as an informational element. The activities on the left side of an interactive notebook *(in* and *out)* are meant to

- engage students with the new information included on the right side of the page *(through),*
- assess student understanding both prior to and after instruction,
- emphasize their thinking about thinking (metacognition), and
- create representations of their understanding that demonstrate learning (Figure 2).

In and *out* activities are distinguished by their purpose, not by the types of strategy employed. In fact, depending on the lesson goals, the *in* and *out* activities might use the same strategies. For example, students may be asked to review concepts from a previous lesson by contrasting and comparing during an *in* activity (e.g., mitochondria versus chloroplasts). Or, they may be asked to contrast and compare an *out* activity following a *through* lesson (e.g., plant versus animal cell structure).

Interactive notebooks are designed to foster thinking, writing, and documenting science in a variety of

FIGURE 1

Structural overview of an interactive notebook.

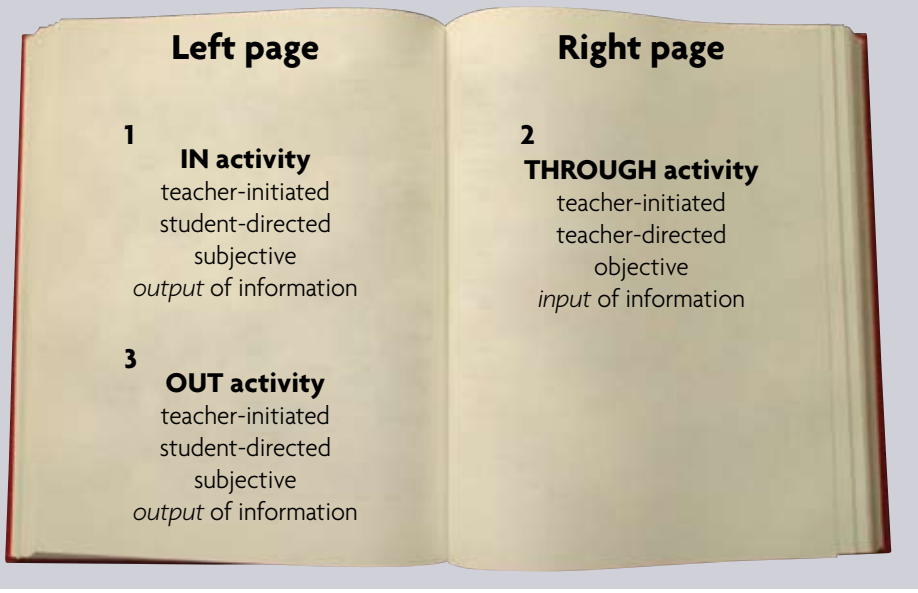


FIGURE 2

Example interactive notebook activities.

Left side	Right side
Examples of student-directed *in* and *out* activities:	Examples of teacher-directed *through* activities:
◆ A drawing, photo, or magazine picture that illustrates a new concept or idea	◆ Lecture, discussion, or reading notes
◆ Questions, opinions, and personal reflections about the new information	◆ Laboratory procedure or rough draft
◆ Predictions, contradictions, or quotations relating to the *through* activity	◆ Film, video, and documentary facts or notes
◆ Practice problems or inquiry activities	◆ Small- or large-group discussion notes
◆ Metaphors, analogies, acronyms, poems, songs, or cartoons that capture the new information or issue	◆ Collaborative group process summary
◆ Connections between the information, and the student's life, another course, or the world	◆ Excerpts of a news or journal article
◆ Reflections on and summary of activities	◆ Vocabulary exercises
	◆ Worksheets and activities

formats. Most current, high-level strategies for inquiry science are easily adapted to the pages of an interactive notebook. These include Vee maps (Coffman and Riggs 2006; Roehrig, Luft, and Edwards 2001) or the science writing heuristic (Hand and Keys 1999), as well as note-taking systems such as Cornell notes (Pauk 2006).

Empowerment

At professional development programs across our large school district, we hear teachers speak of the interactive notebook being successfully implemented in all forms of high school science (e.g., biology, chemistry, physics, Earth science) at various levels (e.g., introductory, honors, advanced placement). While the depth, breadth, and general requirements of the strategies vary based on classroom and curricular factors, the cycle of *in-through-out* activities is consistent among all classes that have used it successfully.

Our personal classroom research indicates that interactive notebooks contribute to learning; students perceive them as tools that positively impact their ability to learn science; and the notebook increases their ability to organize the materials associated with learning. Figure 3 (p. 54) illustrates the positive relationship between student notebook scores and final course grades for a group of students over one quarter of instruction. Student grades increase proportionally to their notebook scores—we believe the interactive notebook accounts for a significant amount of increased student learning.

Interactive notebooks can empower students for learning science because they

- require active engagement with course concepts;
- incorporate self-reflection;
- allow students to express their personal values, experiences, and feelings;
- teach organizational skills;
- create pride in and ownership of class work; and
- help students visualize and demonstrate understanding as evidence of self-regulation.

The *in* and *out* activities of the interactive notebook require students to actively engage with the language, concepts, and skills of the curriculum. Active learning requires self-reflection and the explicit integration of new knowledge and experiences. Learning environments that include these components demonstrate a strong relationship with student achievement (Tuan, Chin, and Shieh 2005).

Emphasizing self-reflection affords students the opportunity to identify weaknesses in their understanding and to establish the personal relevance of ideas presented in the *through* activities. The interactive notebook also provides opportunities for students to engage in self-reflective and collaborative experiences that allow for meaningful negotiations between peers and the teacher. Students within a group may differ in their interpretation of and subsequent conclusions about data. At this point, the teacher may act as facilitator to ensure that student consensus occurs.

While acquiring and integrating new knowledge and skills, students come to view the notebook as a personal, organized, and documented record of their understanding. Each student's notebook becomes a unique expression of their effort and creativity, as well as a demonstration of their pride in and ownership of their work. Working within the interactive notebook, students become aware of the knowledge and skills required to control their learning—an understanding that can contribute to confidence and feelings of empowerment (Pajares 1996).

Student perception of the notebook's importance for success is often based on the organizational components of the process (e.g., numbered pages, a table of contents, handouts affixed to pages, and left- and right-side activities). By knowing where to locate the materials needed for learning, students feel more confident in their ability to learn science. The following student quotation, representative of most student comments from our classroom research, highlights how a student's perception changes with use of an interactive notebook: "This is the only class I am organized in. I feel more organized than I ever have before."

Implementation

In the first days of the school year, each student is provided with (or must obtain) an identical spiral notebook. Once students have their interactive notebooks, the learning cycle begins and quickly becomes the daily routine. The structure of the *in* and *out* activities creates positive learning actions focused on sensemaking.

A strict format for introducing these tools should be designed in advance and followed closely. Our script includes the following rules:

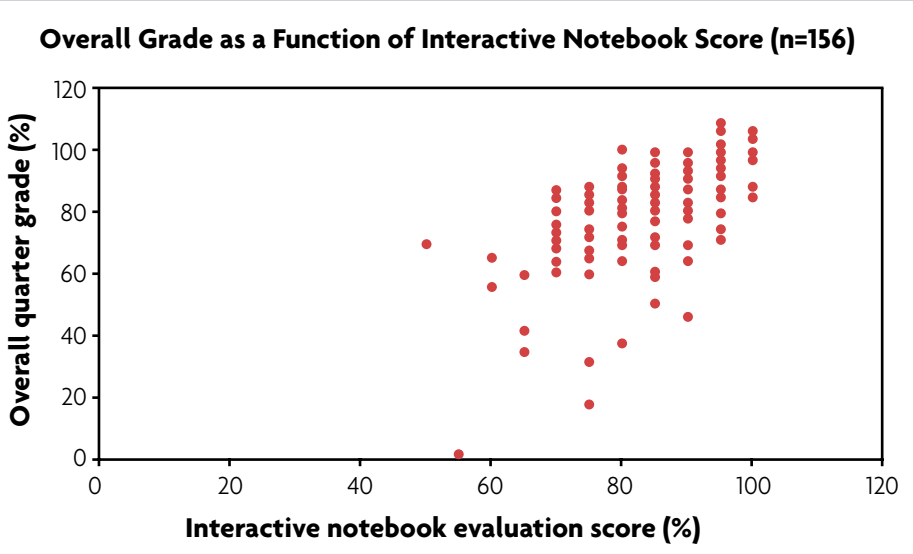
- The process of an interactive notebook should be thoroughly explained to students, and a follow-up explanatory letter should be sent to parents.
- Only spiral bound notebooks should be used so the notebook can fold in half (no three-ring binders or bound-composition notebooks).
- A spiral notebook of about 70–100 pages is typically needed for one semester of work.
- Notebooks are taken home or securely stored in the classroom.
- All students should number their pages the same way (left side: even, right side: odd).
- Pages should not be torn out of the notebook.
- Students should write only with pencil, as use of ink pens promotes the tearing out of pages when mistakes are made. If pens are allowed, the teacher must strongly enforce the rule on not tearing out pages.
- Glue or tape is used to attach handouts or photocopies to the spiral-bound pages.
- Covers and inside pages should be designed to reflect defined criteria such as laboratory format, instructions for equipment use, author page, grading rubrics, or assignment types.
- At the beginning of the notebook, pages are set aside for reference handouts and a table of contents.
- Score sheets, grading rubrics, and assignment types should be affixed to the same place in all notebooks.
- Colored pencils, scissors, and glue sticks or tape (double-sided works best) are required daily supplies that need to be brought to class or supplied by the teacher.

If multiple sheets need to be affixed to notebook pages at the beginning of a new unit, then students participate in a "glue festival" to attach handouts, labs, note outlines, and so on. For efficiency, students are given a limited amount of time (e.g., approximately 10 minutes). Trimming papers, gluing and coloring the various diagrams, and responding to the *in* and *out* prompts contribute to the degree of personal ownership and on-task behavior related to this learning strategy.

FIGURE 3

The impact of student notebooks.

Some exams included extra credit questions that resulted in final grade percentages higher than 100%.



Assessment

Since nearly all student work is completed in the notebook, assessment is simplified. However, the teacher is not required to take home and read hundreds of notebooks. Figure 4 summarizes a variety of easily adaptable grading techniques. Scores can be recorded on a seating chart,

FIGURE 4

Assessment strategies for an interactive notebook.

Quick grades for *in* and *out* activities:

- ✓ The teacher walks around the room or students hold up notebooks for a visual inspection.
- ✓ The teacher uses the seating chart to record scores or stamps student notebooks individually to verify assignment completion.
- ✓ Students complete a simple teacher-designed self-evaluation form and hand it in.
- ✓ A 3-point rating scale is used for feedback (Wow = 3, What is expected = 2, Made an attempt = 1).

Summative evaluations:

- ✓ Completeness is evaluated two to four times a semester.
- ✓ Rubrics are created and used for grading paragraphs, summaries, and other more complex student work.
- ✓ At the end of semester, rubrics with a standard numerical score are used to measure quality, depth, effort, completeness, organization, and improvement.

within each student's notebook, or summarized on small slips of paper.

Conclusion

The power of an interactive notebook resides in students' engagement with sensemaking, metacognitive activities. Oftentimes students arrive to class and immediately launch into challenging new material, without setting the context by reflecting on previous classes. Similarly, classes sometimes end in midstream, finishing with the closing bell rather than with a reflection on the big ideas learned that day. *In* and *out* activities help teachers avoid these situations and provide an opportunity for students to reflect on their learning. While we suggest that the format of the interactive notebook be strictly defined, the utility of the design allows for the inclusion of a wide range of existing classroom activities.

Over the past few years, a good number of teachers from across our school district have been using action research in their classrooms to evaluate the impact of the interactive notebook. The response we hear is universally positive: These strategies are helping students engage in and learn science. Workshops for teachers on using the interactive notebook are very popular, and participating teachers who go on to implement interactive notebooks comment that they will never go back to their previous strategies. Although the results of this research are incomplete, we find the endorsement by respected colleagues to be encouraging.

Students treasure their interactive notebooks because they are personal and reflective; teachers value them because they represent a simple yet powerful method for helping students learn science.

Working with the interactive notebook, students come to value sensemaking and become aware of the knowledge and skills required to control their learning. This in turn empowers students to become confident and focused, thereby improving their achievement. Students treasure their interactive notebooks because they are personal and reflective; teachers value them because they represent a simple yet powerful method for helping students learn science. ■

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