Assessing Instructional Materials for Inquiry: A Workshop

Session Overview

This document[1] is designed to be used with a group of teachers in a workshop setting. The *Assessing Instructional Materials for Inquiry* workshop is most appropriate for practicing teachers. However, administrators, science curriculum directors, pre-service teachers, and graduate students (teachers working on advanced degrees in science education) would also benefit, especially if the facilitator adapts the instruction for the specific audience.

Session At a Glance

Phase of Instructional Model	**Session Activity (Participants will:)**	**Suggested Time**
Engage: Section I Learner connects past and present learning experiences and organizes own thinking toward learning outcomes of this session	Promote curiosity through sharing scenarios; access prior knowledge by reviewing essential prior knowledge; preview workshop; state workshop goals	15 minutes
Explore: Section II Concepts, processes, and skills are identified and developed	Work collaboratively to evaluate inquiry activity examples, drawing upon prior knowledge to generate ideas about how to conduct this process, and then how to use *Instructional Materials Rubric*	45-90 minutes
Explain: Section III Learners demonstrate their conceptual understanding, process skills, and behaviors	Present results of exploration phase; through mutual sharing, discussion, and questioning arrive at understandings regarding use of the *Instructional Materials Rubric*	45-90 minutes
Elaborate: Section IV Extend conceptual understanding and skills, using new experiences to stimulate deeper understanding, acquisition of more information, and development of adequate skills.	Conduct additional evaluations, practicing assessment skills by applying *Instructional Materials Rubric*to new materials; receive feedback	30 minutes to 2 hours
Evaluate: Sections VI, VI and VII Learners assess own understanding and abilities	Assess personal progress and reflect upon practice; summarize workshop; participate in structured follow-up activities	15 minutes and open-ended follow-up

[1] Remove paragraphs 1, 3, and 4 if this material is reflected in the Guidelines.

Definition:

This workshop guides participants through the process of evaluating instructional materials for their alignment to the principles of science as inquiry, using the *Instructional Materials Rubric*.

Purpose:

Learners will be able to skillfully apply the *Instructional Materials Rubric* to evaluate the potential of science education materials to involve students in inquiry science. Using this rubric answers the question "Are these materials appropriate for my students at their current stage of development of inquiry skills?" As parts of this overall goal, learners will:

- Understand all the terminology and concepts represented in the *Instructional Materials Rubric*
- Match features of science materials to variations in the *Rubric*
- Apply the rubric in a way that matches the judgments of a majority of other evaluators or experienced teachers

Essential Questions:

- What are the characteristics of instructional materials that facilitate rich science as inquiry experiences for students?
- How might teachers evaluate instructional materials intended to support science as inquiry learning?

Objectives:

- Teachers will understand all the terminology and concepts represented in the rubric
- Teachers will match features of science materials to variations in the rubric
- Teachers will apply the rubric in a way that matches the judgments of a majority of other evaluators or experienced teachers

Conceptual Learning Sequence:

Prerequisites for this workshop include:

- An understanding of the Definition of Science as Inquiry, and/or
- Completion of the *Science as Inquiry Workshop* in this professional development package

After this workshop, the next logical workshop in this package is *Revising Curriculum for Inquiry*.

This workshop roughly follows the 5E Instructional Model , in an effort to demonstrate inquiry-based pedagogy; however, it differs from the 5E model in two key ways. First, this workshop deals with skill development rather than the development of conceptual understanding. Second, we know that in most professional development programs instructional time is severely constrained. These factors contribute to a modification of certain portions of the 5E model.

Materials

- Projection system (overhead projector and/or computer projection system)
- Chart paper, easel, markers

Handouts [*under construction]

1. Session-at-a-Glance
2. Activity 1 (with strong inquiry characteristics)[2]
3. Activity 2 (with weak inquiry characteristics)
4. Science as Inquiry Definition
5. Summary of *Science as Inquiry Workshop*
6. *Instructional Materials Rubric*
7. Activity 3
8. Activity 4
9. Rubric Responses from Experienced Teachers (Key to Activities 3 and 4)
10. Personal Development Resources
11. Activity 5: 321 Crash (accompanies Resource D)
12. Blank Rubric worksheet (accompanies Resource D)

Facilitator's Resources

A. The Value of Inquiry
B. Background of the *Instructional Materials Rubric*
C. Getting the "Big Picture" of the *Instructional Materials Rubric*
D. *Rubric* Scoring Demonstration

Note to Facilitator:

Text at the left margin in Times New Roman font is aimed at the facilitator of the workshop. Indented text in `Courier` font is sample dialog that the facilitator can use to address participants attending the workshop. That is, "you" in left margin Times New Roman text means the workshop facilitator, while "you" in indented `Courier` font refers to the workshop participant. Significant events in the workshop are numbered sequentially throughout.

[2] Suggestion for all Activities: NASA online materials

ENGAGEMENT

Overview:

Learner connects past and present learning experiences and organizes own thinking toward learning outcomes of this session. The purposes of this brief Engagement phase are to promote curiosity through sharing scenarios, review essential prior knowledge, preview workshop, and present workshop goals.

Section I: Audience Description, Prior Knowledge, and Workshop Goals

1. Begin by finding out who your audience is.

    What professional role brings you to this workshop?

Choose one or more of the following scenarios based upon the positions of attendees. (Suggestion: use transparency or *Powerpoint* slide)

> You are responsible at some level for ensuring that standards are met. Your standards require that students carry out inquiry-based science projects. Therefore, you need to be able to recognize a good inquiry activity when you see one. *Example: You are a teacher who is trying to meet Standard X* (substitute a local mandate here). *You have found an activity on the Internet purporting to support science as inquiry. How can you know that this activity truly reflects the principles of inquiry? Using the* Rubric, *you can assess the activity for its inquiry value.*
>
> You have been asked to help select science materials or textbooks. How do you recognize good inquiry materials when you see them? The *Rubric* is a tool that you can use for this purpose. *Example: You have been asked to serve on a statewide textbook selection committee. What are the top three science texts on the market today? The* Rubric *can help you determine which texts best present inquiry-based science as a whole.*
>
> You are interested in carrying out only a small aspect of inquiry in a given science lesson. You can use the *Rubric* to help identify activities that do a good job of presenting a specific aspect of inquiry. *Example: You are a second-grade teacher who wants to emphasize the skill of observation within a large investigation involving the characteristics of rodents as shown by the class' pet hamster. The textbook includes a worksheet that suggests ways the students can "watch" the hamster, including tallying the amount of sleep during daylight hours and the amount of food that it eats. Is this activity inquiry-based? The* Rubric *can help you decide.*
>
> Perhaps you know a little about science as inquiry, but need to know more. At the same time, you must begin incorporating inquiry into your science curriculum. This *Rubric* may help you increase your understanding while simultaneously helping you to select inquiry-based materials. *Example: You are a curriculum director with a general elementary background. Although you know a great deal about the*

elementary science curriculum, you need more specific knowledge about science as inquiry. Using the science materials your local system has in place, you can use the specific Rubric *level descriptors to improve the quality of inquiry present in the system's curriculum.*

You would like to develop good science inquiry materials. The *Rubric* can guide your efforts. *Example: You teach high school biology, and over the years you have developed a project about fetal pigs that students seem to enjoy. You suspect, however, that this project does not truly involve students in all aspects of inquiry as you would like it to. How can the project be improved? You can use the* Rubric *to help you identify specific areas in which the project can be aligned better with the principles of science as inquiry.*

2. Present workshop goals:

Learners will be able to skillfully apply the *Instructional Materials Rubric* to evaluate the potential of science education materials to involve students in inquiry science. Using this rubric answers the question "Are these materials appropriate for my students at their current stage of development of inquiry skills?" As parts of this overall goal, learners will:

- understand all the terminology and concepts represented in the *Rubric*
- match features of science materials to variations in the *Rubric*
- apply the rubric in a way that matches the judgments of a majority of other evaluators or experienced teachers

3. Present session overview. Provide a printed handout (Handout 1) of Session-at-a-Glance, adapted to include breaks and accurate timeframes.

EXPLORATION

Overview:

In this section, concepts, processes, and skills are identified and developed. Learners work collaboratively to evaluate inquiry activity examples, drawing upon prior knowledge to generate ideas about how to conduct this process, and then how to use the Instructional Materials Rubric.

Section II: Explore techniques for assessing inquiry materials

4. Pose the following question to the group. Ask them to reflect individually. Chart some or all of their responses.

What strategies and tools do you now use to assess instructional materials for inquiry?

5. Divide participants into groups of 2 or 3. Provide two brief sets of instructional materials to workshop participants, one with strong inquiry characteristics and the other without (Handouts 2 and 3). Direct the groups to examine the materials, and discuss the potential of each as inquiry activities.

> `Here are two examples. In groups of 2 or 3, examine them and consider whether or not they reflect inquiry. Make sure to talk about why, and list specific characteristics of the activities that are related to inquiry.`

6. Provide 15 minutes of working time on each set of materials, more or less depending upon group progress.

7. Ask each group to report, briefly, giving their evaluations of the materials and several characteristics of inquiry. If the groups agree upon their assessments of the activities, and name several characteristics of inquiry, then their level of prior knowledge is fairly high. If they don't agree, then use this disagreement to help make the point that coming to consensus on assessing inquiry materials is difficult.

8. Briefly review the *Definition of Science as Inquiry* and key ideas from the *Science as Inquiry Workshop*.

- Refer to Handouts containing the Definition (Handout 4) and major points from *Science as Inquiry Workshop* (Handout 5[3]).
- Acknowledge the value of inquiry-based science-teaching as an assumption of this workshop (see Resource A).
- State that this workshop assumes prior knowledge of these two elements.

9. Distribute the *Instructional Materials Rubric* (Handout 6). Using the same set of materials and the same groupings, invite participants to spend 30 minutes or longer evaluating the same two materials with this tool.

EXPLANATION

Overview: Learners demonstrate their conceptual understanding, process skills, and behaviors. They present results of exploration phase; through mutual sharing, discussion, and questioning arrive at understandings regarding use of the Instructional Materials Rubric.

Section III: Verbalizing Current Understandings

10. Report out from Step 9. Ask each group to explain what they did, and to share some of their scores. Ask them to share the challenges they had, and what they did not understand. Chart these challenges and make sure you address them by the end of the session.

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[3] Use materials directly from *Science as Inquiry Workshop* if possible.

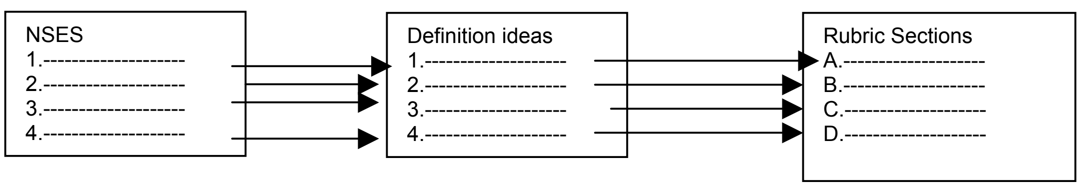
11. Arrive at an understanding of how to apply the *Instructional Materials Rubric*: Below is a list of understandings that participants will ideally arrive at during this Explanation phase. It is your challenge, as facilitator, to help them arrive there, posing questions to stimulate their thinking as much as possible.

Sample questions:

- Now that you've had a brief introduction to the *Rubric,* what challenges do might you have in using it?
- What additional knowledge do you need in order to use it?
- How might you use the *Rubric* in your own teaching context?

Ideally, this phase would take as long as necessary for all participants to arrive at these understandings. Given time constraints, it may be necessary to deliver these points in a direct manner when the time allotted for this phase is over.

- Rubric outline is based upon the Definition, which is in turn based upon the NSES. Participants should understand how the *Rubric* takes ideas from the Definition and operationalizes them (see Resource B).



- Meaning of each of the four major *Rubric* sections (see Resource C if more guidance is necessary)
- All concepts represented within the *Rubric*, and/or where to find clarification for specific terms
- What the Variations mean
- How to score materials using the *Rubric*. If direct instruction about this is needed, refer to Resource D (Demonstration).
- What to do with the scored materials; that the *Instructional Materials Rubric* is not designed to generate overall scores, but to align materials against specific aspects of inquiry
- Although the *Rubric* is large, working through it thoroughly in the beginning leads to much quicker completion later on. Also, teachers may wish to create their own personal "shorthand" version of the *Rubric;* this process would allow them to synthesize it for themselves and create a useful tool for day-to-day application.

ELABORATION

Overview: Learners extend conceptual understanding and skills, using new experiences to stimulate deeper understanding, acquisition of more information, and development of adequate skills. They conduct additional evaluations, practicing assessment skills by applying the Rubric *to new materials, and receive feedback.*

Section IV: Practice and Feedback

Materials:

- One or more science activities that have been pre-assessed by many people, different from earlier activities (Handouts 7 and 8)
- Separate copies of responses to Rubric (by experienced teachers) for these activities (Handout 9)

12. Have learners group themselves in pairs. Direct them to apply the entire Rubric to Activity 3 (Handout 7), giving them approximately 45 minutes to work (more, if time permits).

13. Provide feedback in one or more of the ways below (choose the most appropriate for your group of learners):

- Discuss the ratings orally. Emphasize that these ratings are not necessarily right or wrong, but are the ones most often chosen by experienced teachers. For each descriptor, discuss reasons why the experienced teachers chose the answers they did, and speculate about why they did not choose the level higher or lower.
- Encourage learners to discuss within their pairs where they agreed and disagreed with the experienced teachers' assessments. Invite learners to discuss points of confusion with the whole group.

Learners may continue this practice/feedback loop on their own after the workshop is over, using fresh activities that have been scored by experienced teachers.

EVALUATION

Overview: Learners assess their own understanding and abilities. They assess personal progress and reflect upon practice. In this section, the workshop is summarized, and participants are encouraged to participate in structured follow-up activities.

Section V: Formative Assessment

14. Choose from among these suggestions for gathering and using assessment data:
    - Informally observe learners as they work during the previous activity. Note where there are large discrepancies between learners' responses and the experienced responses. While the learners continue to work, reflect upon how to address these challenging areas. For example, if you observe learners struggling to choose between

two levels on a particular *Rubric* descriptor, stimulate them to think of examples of activities that match each of the problematical levels.
- Ask learners to fill out a Scantron sheet as they work through Section VI. They need not write their names on them. Take these up at the end of the period and run through the Scantron machine. Use the aggregate scores as formative feedback to determine whether or not another round of practice/feedback is necessary, and to target specific areas of weakness.
- To provide feedback to participants, they may write "make-believe" names on their scantron forms (to prevent possible embarrassment). Then, if desired, you may make the scored forms available for learners to pick up for personal feedback. You may use this feedback as a launching point to review or discuss the *Rubric* scorings in a large group setting.
- [*Save this as a placeholder to direct participants to online assessment tools, when they become available: If computers with Internet access are available, the participants may input their choices into the computer and then you may present the aggregated profiles generated for the activity being reviewed. This could serve not only as a launching point for the value and application of the *Rubric* to administrators, but it would provide feedback for each person attending the workshop and to the workshop facilitator.]

Section VI: Reflection and Summary

15. Challenge learners to think about the instructional materials in their own classrooms. Ask them to consider an activity they always use and how it would score if compared to the *Rubric*. Encourage them to write a personal Action Plan that includes a personal goal for professional development related to inquiry along with several strategies for accomplishing that goal.

Discussion points, as a way of wrapping up the workshop:

- How might you use this Rubric in your teaching? Invite specific examples and ideas.
- How will you share it with colleagues (on-site, in your district, at state/regional meetings)?
- How might you change specific activities to make them more inquiry "friendly?"

16. Making the *Instructional Materials Rubric* your own: The *Rubric* is large and unwieldy, reflecting the complex nature of the inquiry process. If teachers apply the Rubric several times in its entirety as they learn to assess and select inquiry materials, their understanding of this process and of inquiry in general will greatly improve. Once this understanding is achieved, it is less important to use the entire *Rubric* each time. Point this out to workshop participants, especially when they remark about how long the *Rubric* is. Further, encourage teachers to create mini-Rubrics or other shortened, personal adaptations of the Rubric for themselves. While it is important that all concepts remain in any such reduced or "shorthand" version, the reduction process is a learning experience and a way of internalizing its ideas.

Section VII: Follow-up

17. If this workshop will be used in conjunction with face-to-face or online collaborative opportunities, it would be beneficial to convene local Inquiry groups periodically throughout the year and have them discuss any/all of the following topics:

1. What treasures have you found and why did you rate them so highly? Share activities matching specific content objectives that score highly on the Rubric. Share tips for actually conducting the activity.
2. What challenges have you faced and how did you overcome them?
3. What has worked well; what success stories do you have?
4. What progress have you made on your Action Plan?

For example, any school or group of schools could sponsor an Inquiry Special Interest Group for the term of a year. This group could meet monthly and discuss the points above, and it could be highly organized or not. Another alternative is to form a group with people geographically distanced through the Internet.

18. Present several ideas and resources for individual development from Handout 10.

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Handout 10: Resources for Personal Development

Annenberg/CPB

Annenberg/CPB has developed a series of workshops with videos that address different phases of inquiry. For an overview of this resource go to: http://www.learner.org/catalog/science/lsseries/ and select "Program Descriptions" to see what each video in the series discusses.

You may also visit http://www.learner.org/channel/workshops/inquiry/ for additional inquiry suggestions for augmenting your teaching. For example, going to: http://www.learner.org/channel/workshops/inquiry/implementing2.html will provide you with a detailed outline of how to do an inquiry investigation with your students.

National Science Teachers Association-Inquiry and Learning Publication

The National Science Teachers Association in conjunction with * recently published an addendum to the National Science Education Standards that more fully addressed the components of inquiry-based learning. While available in print, it may be found online at:
http://www.nap.edu/readingroom/books/inquiry_addendum/

Networking for Leadership Inquiry and Systemic Thinking:

Also, NASA has funded a multi-year systemic project that is looking at how the educational system as a whole should change to address inquiry-based learning. Managed by the Council of State Science Supervisors, national leaders are currently pilot testing an in-depth online rubric that may be used to assess inquiry in instructional materials. It may be found online at:
http://www.inquiryscience.com/inquiry/resources/samplerubric.htm

The Exploratorium Institute for Inquiry:

Created in response to widespread interest in inquiry-based science instruction, the Exploratorium Institute for Inquiry provides workshops, programs, on-line support, and an intellectual community of practice, which afford science reform educators a deep and rich experience of how inquiry learning looks and feels.
http://www.exploratorium.edu/IFI/

Disney Learning Partnerships
Concept to Classroom-A Series of Workshops:

Here you may participate in free online workshops on a myriad of topics, such as (a) Cooperative and collaborative learning, (b) Constructivism as a paradigm for teaching and learning, and (c) Inquiry-based Learning, all of which are related. Online discussion boards will allow you to join your colleagues as they share their thoughts and ideas. The inquiry workshop provides audio and video vignettes of classroom inquires and commentary from leading inquiry experts in the US.
http://www.thirteen.org/wnetschool/concept2class/index.html

Resource A: The Value of Inquiry

Few professionals in the science education community today believe that science education should exclusively involve rote fact recitation at test time. Inert knowledge devoid of deeper conceptual understanding limits the application and transfer of knowledge to new and unique situations. Many scholars agree that while relevant prior knowledge is prerequisite for construct development, content knowledge alone does little to advance the habits of mind and comprehension of the scientific process that we wish to develop in our students (Council, 2000)(National Research Council, 2000). At least since the days of John Dewey, inquiry learning has been suggested as a solution to this problem.

At its core, inquiry embodies the scientific method. Students participate in experiments and investigations that require them to develop questions and hypotheses, collect data, analyze data, and draw and test conclusions. Inquiry learning typically seeks to excite curiosity in students, encouraging them to investigate questions on their own initiative and grounding this activity in authentic situations. In addition to the basic abilities of conducting a scientific investigation, inquiry learning should include an understanding of how scientists do their work (Council, 2000). As part of these two key elements, science inquiry should engage students in the overall evaluation of existing and evolving scientific knowledge.

Working from this basic and traditional understanding of the nature of scientific inquiry, substantial research supports the efficacy of inquiry as an instructional model. The Addendum presents some of these research findings, drawing heavily upon Bransford, Brown, and Cocking's (2000) report called *How People Learn*. This comprehensive report provides not only key research findings regarding inquiry, but also explanations for why inquiry has enjoyed success as an instructional method:

- Understanding science involves more than obtaining a knowledge base alone, including comprehending what these ideas mean, application of these ideas, and strategies for scientific thinking and problem solving
- Students build scientific understanding (as well as misconceptions) at least in part upon observations they have made about the world around them
- Students modify scientific understanding when they discover conflicts between their observations of the natural world and their understanding, adapting new explanations that seem plausible to them
- Learning is a social activity, and students specifically "benefit from opportunities to articulate their ideas…challenge each others' ideas, and in doing so reconstruct their own ideas" (p. 119)
- Powerful learning situations involve metacognition, initiative, choice, and some degree of control on the part of the learner
- When students comprehend concepts, they are better able to transfer this understanding to new contexts

Further support for encouraging inquiry in science teaching based upon research is presented in the form of seven arguments, summarized by Lazarowitz and Tamir (Lazarowitz & Tamir, 1994). Briefly, these arguments are:

1. Concrete activities and manipulatives help students grasp abstract concepts
2. Inquiry participation allows students to experience the "spirit" of science and understand how it works
3. Inquiry promotes the development of higher order thinking skills
4. Inquiry promotes the development of basic skills, including communication and facility with science procedures
5. Inquiry provides the opportunity to grasp the components of the scientific method, such as hypothesizing, assumptions, predictions, and conclusions
6. Inquiry promotes habits of mind associated with science, such as openness, skepticism, curiosity, and honesty
7. Students enjoy hands-on exposure to scientific ideas, and may have increased motivation to learn science

According to Haury (1993), inquiry-based science can produce scientific literacy, knowledge of science procedures, vocabulary, conceptual understanding, and positive attitudes toward science. In a meta-analysis of 140 studies comparing a number of science pedagogies, Wise (1996) found a mean effect size of +.28 for inquiry-based pedagogies. In addition, he found that themes of inquiry pervaded other successful alternative methods of science teaching as well. In 1999, Von Secker and Lissitz (Von Secker & Lissitz, 1999) found that laboratory inquiry correlated with greater science achievement. In summary, research produces a "pattern for general support for inquiry-based teaching" (National Research Council, 2000, p. 126).

[References needed*]

Click here to go back to Section III.

Resource B: Background of the *Instructional Materials Rubric*:

Narrative explaining Rubric history:

- Council of State Science Supervisors saw the need for a Rubric like this.
- The Rubric was developed by a working group of science educators, including someone who had worked on the NSES, a president of NSTA, NASA representatives, and many state level science supervisors.
- Rubric was assessed and revised after examination and application by all the CSSS.
- Rubric was further assessed and revised after comments from scientists and college level science educators
- Add any reliability data we may have gained from inter-rater reliability testing.*

Resource C: Getting the "Big Picture" of the *Instructional Materials Rubric*

Introduce the Rubric in outline form (attached below). Presenting the skeleton of the Rubric first allows learners to see the "big picture" before becoming lost in the details and overwhelmed by this large Rubric.

Examine its anatomy, using the outline below:

- Introduction - highlight key ideas from the Introduction*
- Sections A, B, C, D, and theme of each section
- Descriptors
- Variations (levels) and the continua upon which they are based (from dependence to independence, etc.)

[*Insert *Instructional Materials Rubric* Outline here]

Resource D: *Rubric* Scoring Demonstration

Section overview: Think aloud demonstration: model an example scoring using part of the Rubric on a short activity. Provide exemplary examples of "science as inquiry" and non-exemplary examples of "science as inquiry." Provide reasoning behind why the examples were scored as they were by a large group of experienced teachers.

Materials:

- Handout 11: sample "inquiry" activity, such as 3-2-1 Crash from NASA (provide link here)
- Handout 12: a blank rubric worksheet
- Audiovisual means of displaying Handouts 11 and 12, with the capability of "marking" (such as transparencies with markers, or computerized display that you can edit)

Demonstration Scenario

Describe the setting for this scenario, inviting participants to "pretend": 7th grade science teacher reconsiders a favorite inquiry activity to find out if it really involves inquiry. Configure this setting to match learners' situation as much as possible.

Ask learners if any have used this activity before, and invite accounts if so. Then, give learners an opportunity to familiarize themselves with the activity (5-10 minutes). Have someone give a thumbnail description of the activity for the group. (3-2-1 Crash! is a NASA activity for grades 5-8 involving video, construction, and trials. There is a web component as well. Students build dragster, propel it with fizzy tablets, measure and collect data, analyze results "just like NASA researchers.")

A script for how the demonstration might go:

For now, let's assume that the activity's content is relevant to whatever curriculum we need to follow, thus satisfying Section A of the Rubric.

In front of you, have the activity in one hand and the Rubric in the other.

Let's look at Section C, and I will model for you how I might apply this rubric to this activity. Consider several descriptors, marking boxes on Handout 12 along the way. Invite participants to mark along with you.

Continue as long as needed.

Take a few moments to discuss what the learners observed:

How did I do? Did you disagree with me anywhere? If so, where and why?

Accept the learners' feedback, and explore reasoning without telling them they are wrong.

References

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