Writing a Technical/Procedural STEM Problem

Technical/Procedural STEM problems are often too tight and restrictive, and at other times, they're vague and lacking in detail. But, well written technical/procedural STEM problems can lead students to new STEM learning. If done right, technical/procedural STEM problems can have an important effect on knowledge gain among students. If students know what to do, when to do it, how to do it, and how not to get it wrong, you can reduce frustration and save a tremendous amount of time and effort while focusing on the STEM content. Writing a procedure that is accurate, brief, and readable isn't always easy. Anyone who has attempted to assemble a partially assembled product has learned this lesson the hard way! But, with a bit of knowledge and practice, you can learn effective technical/procedural STEM problem writing skills, and identify great opportunities to improve the quality of your STEM lessons.

What is a technical/procedural STEM problem?

Technical/procedural STEM problems differ from engineering design problems in that they are more structured and the solutions to such problems require background knowledge as well as the ability to follow technical directions. Technical/procedural STEM problem show the students "how to" complete a task or process. Procedures are action oriented. They outline steps to take, and the order in which they need to be taken. They're often instructional, and they may be used in applying newly learned content, but they should never be used exclusively in the STEM classroom or to the exclusion of engineering design problems. Well-written technical/procedural STEM problems are typically solid, precise, factual, short, and to the point.
Many procedures seem "black and white," with clear steps and only one way of doing things: "Complete A, then B, then C." But sometimes you need to be less exact and allow room for personal judgment. When a procedure is too tight, it can cause confusion. Since life isn't always simple and clear-cut, some procedures need to allow subjectivity and individual choices.

When Do You Need a Technical/procedural STEM Problem?

Technical/procedural STEM problems are useful when students have recently been exposed to new content that needs to be applied in the laboratory—particularly content where there are not multiple ways to apply. If there are multiple ways to apply the content knowledge, an engineering design problem would be a better choice. The number-one rule of technical/procedural STEM problem creation is to make sure there's a reason to complete the problem: Perhaps students forget to take certain actions, perhaps they keep getting things wrong, or perhaps the concept is so long and complex that students need a checklist if they're going to get things right. A written procedure is necessary only if the concept is important or if there will be a significant benefit from clarifying a process. Before you begin, ask yourself if people really need or want to know this information.
You need a procedure when a process or concept is:

- Is lengthy (example: constructing a device that will be used for testing).
- Is complex (example: electrical circuits).
- Is routine, but it's essential that students strictly follows rules.
- Demands consistency (example: lab safety).
- Involves documentation (example: developing a STEM journal).
- Involves significant change (example: using a laser cutter).
- Has serious consequences if done wrong (example: safety guidelines).
- There are multiple “wrong ways” to interpret a STEM procedure.
- Students are often confused by a concept or lesson.

How Do You Write a Technical/procedural STEM Problem?

Procedures should communicate what readers NEED to know, not just what they WANT to know. They might need to know how to apply the STEM concept correctly, faster, or with less waste. They also might like to

know why they have to do something a certain way, where they can go for help, and what happens if something goes wrong. Where necessary, make sure your procedures deal with technical issues as well as subjective elements. It's also important that your procedures have the right level of detail. Here are some questions to consider:

- Do users have enough information to complete the problem?
- Is there enough information to guide users in using good judgment?
- Is the level of detail appropriate for the subject?
- Is the level of detail appropriate for students?
- How confident are readers with the subject?

Step One: Gather Information

Before you start writing, gather detailed information on the content you hope to deliver through the technical/procedural STEM problem. Talk with or gather information from content experts as well as others who hold key information – fellow teachers, technical staff, and people who have completed similar activities. Take lots of notes, and then sit down with the information and sort it out. As the procedure writer, you want a clear understanding of what's going on in as much detail as possible. From there, cut down the information to what the student really needs to best understand the process.

Step Two: Start Writing

When you write the first draft of your technical/procedural STEM problem, don't worry about exact words and format. The main purpose is to include the information you need. Once you've done that, you can work on the words and organization. Write actions out in the order in which they happen. Start with the first action, and end with the last action. Avoid too many words. Just be specific enough to communicate clearly and use the active voice. Use lists and bullets but don't be too brief, or you may give up clarity. Use the appropriate technical language, but be sure to define words at the appropriate reading level.

Step Three: Assess Design Elements

You may find that words alone aren't enough to explain the technical/procedural STEM problem. Sometimes other elements can help your presentation. Some common formats include flowcharts, tips, scripts, questions and answers, or a matrix.
Additionally, photographs can also be a helpful way to clarify written directions. Remember the old saying – a picture is worth a thousand words. However, good directions with good visual examples or photographs can be invaluable.

Key Points

Well-written technical/procedural STEM problems help students apply recently learned STEM content, help reduce the number of errors and omissions, and help students perform complex tasks quickly and effectively. To get the most out of your technical/procedural STEM problem, follow some simple rules when developing them: Make sure the procedure is necessary. Then write it in a way that's easily understood – using simple, clear words to communicate as briefly as possible. When it comes to how many procedures you need, sometimes the fewer the better. So make sure each procedure is absolutely necessary before you spend time creating it.

Some ideas borrowed from: https://www.mindtools.com/pages/article/newTMC_78.htm