Engineer a Great Middle School STEM Curriculum

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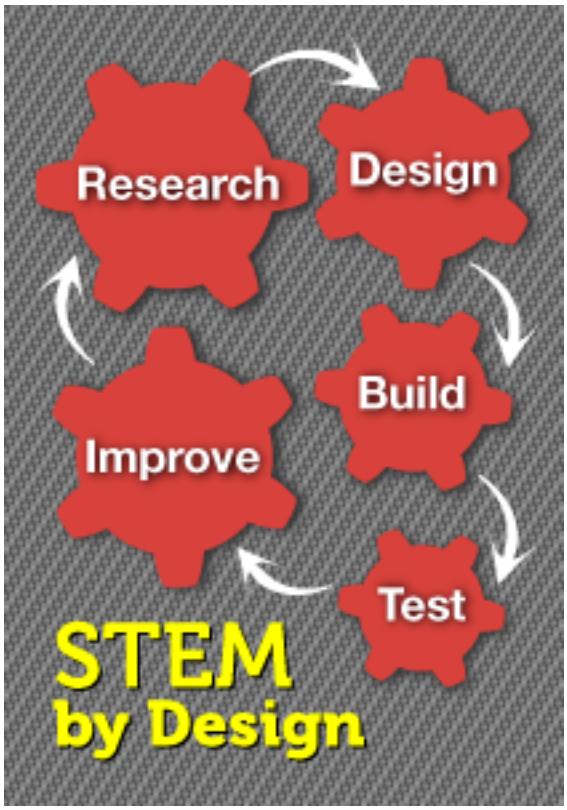

What does a good middle school STEM curriculum look like? We're hearing this question more and more often as schools across the U.S. and elsewhere get serious about establishing STEM learning experiences for their students in the middle grades.

My answer: there's no single, die-cut curriculum that every school should be using. There's plenty of opportunity for hand-crafting an effective teaching and

learning design as teachers and school leaders deepen their discussion about "what we want our STEM program to look like and accomplish."

I imagine this deeper discussion might include these probing questions:

- Are you looking for an integrated, interdisciplinary curriculum involving science, technology, engineering, and mathematics?
- Do you want STEM curriculum to involve students in tackling real-world issues through exploration, inquiry, and problem-solving experiences?
- Can you identify or develop a curriculum that regularly requires critical thinking, creativity, effective collaboration, research skills, and communication?

To be sure, that sounds like an ambitious agenda for any curriculum. All of these ingredients won't be in the mix during every moment of every lesson. But over the course of their middle school journey, you probably want each cohort of middle school students to experience and master STEM learning at the ambitious levels these questions suggest.

Here are 8 things you may want to consider in choosing and/or crafting a successful STEM curriculum. My list is not exhaustive but it addresses the major elements of programs that have been praised for their quality and effectiveness.

1. Is engineering the driving force behind our STEM problem-solving?

The "E" in STEM stands for engineering. It's what makes STEM different from regular science, technology and math instruction. Good STEM curriculum puts a heavy focus on an engineering design process – an organized method of approaching and solving problems. Not all EDPs need look exactly the same (check out these different representations) but they contain a similar series of steps –which do not always have to be addressed in a linear fashion.

If you are considering a curriculum package, look carefully at the power train. Is the engineering design process (EDP) at the heart of the problem-solving approach? The curriculum should involve students and teachers in using this process throughout the STEM challenge – from clearly identifying the problem to creating and developing solutions.

2. Will our students gain a deep understanding of the content areas?

High quality STEM curriculum is not math and science "lite." Rather, through authentic experiences, students should understand how key science and math concepts are applied out in the world. The science and math should be integrated, and math and science teachers

may (it's tempting to say "must") collaborate to provide quality content knowledge. The STEM curriculum you choose should strongly connect the disciplines and eliminate forever the student question, "Why do I need to learn this?"

3. Do our students work to solve real-world problems?

Does the curriculum lead kids to apply problem solving, engineering design, and subject area content to address real social, economic, and environmental situations in their local and extended communities? Throughout their middle school years, students should learn how to ask and investigate questions about the world they experience through daily living.

4. Are our instructional approaches engaging?

STEM teaching should involve inquiry-based lessons where kids carry out hands-on investigations that encourage critical thinking and problem solving. The lessons are not prescriptive and teachers play a facilitator role, providing just enough guidance and monitoring.

Kids should have plenty of opportunity to muck about, make decisions, and test their ideas as possible solutions. Multiple right answers are possible as

students work to solve a problem. The classroom environment is risk-free, and mistakes and design failures are treated as good methods of learning.

5. Does our curriculum address ways of successfully engaging students in teamwork?

Students work in teams to solve STEM challenges. This brings one of the most needed life skills into the curriculum, and develops synergy needed for problem-solving. The curriculum must provide guidance for teachers to help students learn and practice successful team behaviors and personal interaction skills.

6. Is technology used appropriately in addressing our STEM challenges?

Ideally you would have technology available that you need for advanced computer applications, such as structural design, and students would be comfortable using this technology. At the middle level that seldom happens. However, STEM curriculum will likely offer suggestions for math and science apps that students can use with their STEM work, and the Internet can give them quick access to information as they research. Technology should be presented as more than computers; technology includes all tools used to make life easier and better. The curriculum will likely acknowledge that students actually create technologies

as they create products to address real-world problems.

7. Are our students taught communication skills?

STEM lesson planning often overlooks the development of skills that students need to be successful communicators and collaborators. Do team members learn how to brainstorm and critique ideas, reach consensus, and engage in civil disagreement? Does the STEM curriculum offer guidance on how students can productively communicate with team members and others during class activities (emphasis on active!)? What about procedures for sharing and defending their results in a convincing manner?
As students go through the middle years, STEM coursework should help them learn and value productive communication at personal, team and public levels.

8. Does our curriculum include authentic assessment?

Since a big focus of STEM education is inquiry-based learning and the ability to problem-solve, students need to be tested in practical ways that evaluate the complexity of STEM learning. What does success look like in this curriculum? Are students learning more than just basic content? Look for curriculum that suggests

ways to assess changes in creativity, student attitudes, student participation, the classroom environment, teamwork skills, communication skills, and so on. STEM assessments should include periodic checks to see if diverse groups of students are experiencing success. Are all students playing a role in the successful completion of the challenge? If you want STEM classrooms that are creative, risk-oriented and progressive, assessments should collect information about those areas.

The cure for what ails us

Those are my thoughts on what great STEM curriculum would include. Keep in mind that one lesson would be unable to focus on all of these things, but over the course of their middle school experiences, students should become thoroughly immersed in all of these components.

A great STEM curriculum, taught by teachers who know how to engage kids and “guide on the side,” will not only produce more young scientists in the future, it will serve as a true antidote for the most dreaded middle school malady: Boredom.