



Technology Tools to Build a More Accessible STEM Program: Science Literacy, Vocabulary and Discourse



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Use accessible technologies and authentic STEM experiences to encourage “STEM for All”

Mainstream technology tools with built-in accessibility features, and the availability of virtual reality, simulations, and augmented reality present new opportunities for students with disabilities to access and engage with STEM (science, technology, engineering, and math) content. This brief presents ways for educational leaders to incorporate accessible technologies and STEM tools with principles of Universal Design for Learning (UDL) to create STEM programs that are more accessible for students with disabilities to prepare them for a lifetime of scientific literacy and STEM-related careers.

Introduction

STEM education serves as the foundation of innovation in our society. Innovative products often derive from a problem or challenge that requires a unique solution, making it imperative that all students, including those with disabilities, have access to a rigorous STEM curriculum. Thanks to more accessible technologies and a concerted nationwide effort to address underrepresented populations in STEM fields, more individuals with disabilities are pursuing careers in science and engineering.¹ However, many students with disabilities still lack access to a rigorous and accessible STEM curriculum, and may get the message that STEM careers are not for them. This situation places these students at a disadvantage given that STEM jobs are among the fastest growing and highest paid occupations, with STEM jobs expected to grow to more than 9 million by 2022.²

In an increasingly complex world, all students need to be scientifically literate. While some students may go on to pursue advanced careers in the sciences, basic scientific literacy is critical for all students. They need to understand what it means to think like a scientist, and how to evaluate information that is called "scientific". Many of the careers of the future will require that students can to collaborate and solve problems using STEM skills. Struggling students are no exception — they will need the same types of knowledge and skills, and often will require additional supports to be successful.

Research has shown that the most meaningful learning happens when students are engaged in authentic activities that ask them to think and behave like chemists, computer programmers, mathematicians, engineers or archeologists — that is, when they are engaged in activities that mirror the real-life tasks of STEM professionals. These activities might include the use of virtual environments and simulations, developing models of scientific phenomena, and using collaborative tools like Google

¹ Sparks, S.D. Students With Disabilities as Likely to Enter Science Fields, New Fed Data Show. (2017). EdWeek. Retrieved from <http://blogs.edweek.org/edweek/inside-school-research/2017/02/students-with-disabilities-in-college.html?cmp=eml-enl-eu-news3>

² STEM 101: Intro to tomorrow's jobs. (2014). Occupational Outlook Quarterly. Retrieved from <https://www.bls.gov/careeroutlook/2014/spring/art01.pdf>

docs, video conferencing, and online communities. These types of activities can present new challenges for struggling students and those with disabilities.

Science literacy, vocabulary and discourse

To be scientifically literate, students must be able to use scientific knowledge to identify questions and draw evidence-based conclusions.³ They need to master specific vocabulary and be able to use it in their science writing activities (e.g., observations, journals, lab reports). These skills can be particularly challenging for students from different cultures and linguistic backgrounds, or with cognitive and/or language-based challenges.

Struggling students can benefit from focused attention on their background knowledge and vocabulary as part of instruction.⁴ As students move from more general science courses to more in-depth and content-heavy courses, the knowledge and vocabulary required to comprehend required readings and activities become even more critical. This is especially true for students who are English language learners, even if their spoken English is proficient.⁵ Without a strong understanding of concepts and specific content vocabulary, reading and comprehending challenging science texts are difficult for anyone, but can be nearly impossible for struggling learners.

Electronic references

Glossaries, electronic dictionaries, thesauruses, translation sites, videos, and other online references give students opportunities to practice using language in authentic ways. These types of resources are the first level of support for building scientific language and vocabulary. They provide students with a way to access more information about a specific term and to be more independent in their reading of content area texts.

Multimedia to target background knowledge

Teachers can boost student background knowledge, which may be lacking for some struggling students. Interactive websites, encyclopedias, and other free and commercial websites give students opportunities to engage with science content in engaging and varied ways. Multimedia tools can also allow for repeated viewings of a video, animation, or slide show, allowing students to return to the content multiple times and build mastery.

Scientific discourse scaffolds

Discourse scaffolds can provide students with a second level of support in building scientific knowledge and vocabulary. Rather than focusing on individual terms or phrases, students are examining explanations, paragraphs, and longer documents. For example, students can use concept-mapping

³ National Science Board. (2016). Science & Engineering Indicators 2016. Retrieved from <https://www.nsf.gov/statistics/2016/nsb20161/#/report/chapter-7/public-knowledge-about-s-t>

⁴ Heller, R., & Greenleaf, C. (2008). Literacy instruction in the content areas: Getting to the core of middle and high school improvement. Washington, DC: Alliance for Excellent Education.

⁵ Short, D. J., & Fitzsimmons, S. (2006). Double the work: Challenges and solutions to acquiring language and academic literacy for adolescent English language learners (A report to the Carnegie Corporation of New York). Washington, DC: Alliance for Excellent Education.

software to help them visualize the structure of science discourse. Writing templates can be used or created by the teacher to illustrate the general structures that students are expected to use for their writing (such as a lab report). Writing prompts for scientific arguments (e.g., I hypothesized that ..., I observed that ..., my data shows that ...), can help students get started with writing while illustrating the correct format. These approaches may support students who have weak literacy skills, or who are unfamiliar with formal and scientific uses of language.

Implications for educators

There are several options, including technology, for teachers to support and accommodate all students, especially those for whom the language of science is a challenge:

- Pre-teach vocabulary and ensure that students understand nuanced meanings, which can improve students' comprehension.
- Use technologies that can strengthen students' background knowledge and vocabulary proficiency.
- Make the expectations of science discourse explicit and let students know that part of succeeding in science both on tests and in life is using the proper language in scientifically appropriate ways.
- Develop exercises that will help students strengthen their use of scientific discourse, including modeling correct oral and written expressions.

Technology resources

[Adaptive Curriculum](#)

This interactive visualization and simulation software for middle and high school science features many different activities and simulations linked to national science standards. It also features virtual labs, simulations, quizzes, built-in glossaries, lesson plans, and other classroom materials.

[ARKive](#)

Build background knowledge and help students engage with curriculum using the videos, photography and other resources from ARKive, a collection of multimedia materials on endangered species. Games, classroom resources, and lesson plans are available.

[ARKive Magnetic Fridge Poetry Game](#)

Encourage your students to play with science vocabulary to create fun poems about wildlife using the Magnetic Fridge Poetry Game.

[CAST Science Writer](#)

Designed for middle school and high school students, this tool supports writing a science or lab report by breaking down the writing process. The interactive features and prompts guide students through drafting, revising, and editing their reports.

[Draft:Builder](#)

A combination graphic organizing and outlining program for desktop computers, Draft:Builder has a note-taking feature that students can use to expand their ideas after initial brainstorming. The notes can then be dragged and dropped into a basic word processor, making the writing process more efficient.

[The Periodic Table of Videos](#)

Scientists at the University of Nottingham have created a number of fun and engaging videos on various topics in chemistry, including videos illustrating each of the 118 chemical elements on the periodic table. Many of the videos are closed captioned and available with subtitles in a variety of languages.

[Snap&Read Universal](#)

Snap&Read Universal reads both accessible and inaccessible text aloud from websites, images, photographs, PDFs, web-based tests, and more. Snap&Read also adjusts complex text to be more readable, and allows you to capture information and cite your sources. Snap&Read works across Google Drive, email, websites, Kindle Cloud Reader, and PDFs. It also includes study tools and annotations, translates text into 100+ languages, and integrates a bibliography tool to help organize information.

[STEMfinity](#)

Explore this webpage for a library of resources to support STEM instruction for students, K-12, as well as professional development for educators.



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