The Role of E-Learning in Science Education



Introduction

The National Science Teachers Association (NSTA) supports and encourages the use of e-learning experiences for preK–16 science students, as well as for science educators engaging in professional learning in the traditional, informal, or online learning environment. NSTA defines e-learning as the effective learning process created by combining digitally delivered content with learning support and services (Waller 2001). E-learning can and should significantly enhance science teaching and learning and may be used in a blended and coherent fashion to extend onsite learning experiences.

NSTA does not limit the definition of e-learning solely to distance-based online courses or instruction where the learner and instructor are separated by place and time, but considers the following experiences to be within the scope of e-learning: traditional classroom instruction that incorporates the planned and effective use of collaborative and/or interactive digital tools and resources, blended learning experiences that incorporate various combinations of technology-mediated and traditional classroom instruction, distance delivered courses or programs, as well as the rich collaboration and discourse enabled through online learning networks and communities.

E-learning is an increasingly prevalent, viable, and fully recognized method for teaching and learning science (Dede et al. 2004). NSTA supports e-learning as a promising way to:

- more effectively provide access to images of science teaching that embrace three-dimensional learning in a wide range of classrooms with diverse learners (NRC 2012);
- give science educators opportunities to experience firsthand the appropriate use of technology in teaching and learning, and increase their confidence in using these tools in their own practice;
- meet the needs of diverse student and teacher learners with varied preferences for learning and interacting across learning environments (Dede 2005, DoED 2016, Dede et al. 2016);

- reduce the isolation of science educators—especially those in rural areas or teaching specialized science subjects—by providing and expanding access to colleagues and experts (NASEM 2015);
- provide diverse learners—both preK–16 students and educators—with equitable access to high-quality courses, content, learning experiences, and instructors by overcoming barriers of place and time (DoED 2016);
- engage a greater number of teachers in ongoing, high quality peer-to-peer and teacher focused professional learning experiences (CSSS 2015);
- provide remote access—via computers and smart and mobile devices—to networks, data, and scientific instruments that allows teachers and the students they serve to conduct scientific investigations that might otherwise be unavailable to them (NACOL 2008); and
- provide future workers with strong skills and fluency in the convergence of media, which are critical to succeed in the 21st-century workplace (BHEF 2005).

For these reasons, NSTA supports e-learning as a component of everyone's experience in learning science in the 21st century.

Declarations

NSTA considers the following elements key to effective, high-quality e-learning experiences for teachers and students. E-learning experiences should:

- reflect current research on how people learn and the design of effective learning environments;
- be thoughtfully designed and delivered with goals and outcomes clearly stated;
- be accurate, interesting, engaging, relevant, and standards-based;



- be facilitated or guided by fully accessible teachers or instructors skilled in both science content and pedagogy in an e-learning environment;
- incorporate instructional design practices that allow for individual decision making and accommodate differences among learners and their contexts;
- strengthen science teaching and learning through digitally accessible content that has the potential to provide active or constructive learning experiences that enable the learner to gather, analyze, and display data (NRC 2000) and fully engage in simulated real-world problem contexts;
- connect learners—both students and science educators to experiences that emulate how science is practiced in the real world (NRC 2012);
- provide access to meaningful collaborative learning experiences with experts and other learners (CSSS 2015);
- promote frequent interaction between teacher and learner to allow continuous monitoring and adjustment of the dynamic learning environment; and
- conduct ongoing evaluation and assessment of program effectiveness, learner performance, and academic achievement to ensure the highest possible quality of science education. Both formative and summative evaluations should be used to guide continuous improvement of instruction.

NSTA supports e-learning as an important component of teacher preparation and teacher professional learning.

When designed properly, online courses, programs, and professional learning networks and communities for science educators have the ability to provide high-quality opportunities for them to share and engage with like-minded colleagues through discourse as they learn content and pedagogy. NSTA makes the following declarations regarding e-learning as a component of teacher preparation and professional learning:

• Teachers, science supervisors, district leaders, and higher education faculty should be educated consumers of online opportunities, programs, and tools to effectively evaluate their quality and to encourage both preservice and inservice teachers to better understand the value of e-learning.

- Science educators should use online tools to promote sharing of information, discourse, critical analysis, and collaboration between students and teachers at various locations throughout the world.
- School districts and science supervisors should seek, evaluate, and provide teachers of science with high-quality, meaningful learning experiences employing e-learning technologies.
- E-learning experiences should provide teachers of science with accurate, up-to-date information relating to science content and pedagogy.
- E-learning experiences should employ three-dimensional teaching and learning strategies and make their use explicit.
- E-learning experiences should give educators opportunities to reflect on the implications of what they are learning to their own practice.

NSTA supports e-learning for blended instructional approaches for K–16 students.

Instructional technology accessibility and applications in the traditional classroom, as well as virtual schools and courses, are emerging as viable and effective models for teaching important science content and for meeting diverse student needs. E-learning offers expanded instructional options for science educators when appropriate for the learning goals and the learners. NSTA makes the following declarations regarding e-learning for blended instructional approaches for K–16 students:

- Students should have ample opportunities to engage in science and engineering practices and these opportunities may be increased and enhanced through e-learning.
- E-learning experiences should provide opportunities for students to develop and use science and engineering practices, disciplinary core ideas, and crosscutting concepts in order to explain phenomena or design solutions to problems. (NRC 2012).
- School districts should support e-learning experiences for all students and provide necessary resources.
- E-learning experiences and resources, when appropriate, should accurately portray the nature of science.

- K-16 schools should support the use of well-designed virtual labs that have the ability to enhance understanding.
- Students should use e-learning tools in the classroom in the same ways that they will be expected to effectively use these tools in the workplace.

Adopted by the NSTA Board of Directors, September 2008 Revised July 2016

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Suggested Citation:

National Science Teachers Association (NSTA). 2016. NSTA Position Statement: The Role of E-Learning in Science Education.