

**EDUCATION THROUGH EXPLORATION: USING SPACE SCIENCE TO TEACH AND ENABLE EXPLORATION OF THE UNKNOWN.** A. D. Anbar<sup>1</sup>, L. T. Elkins-Tanton<sup>1</sup>, S. Klug Boonstra<sup>1</sup>, Dror Ben-Naim<sup>1</sup>; S. Semken,<sup>1</sup> <sup>1</sup>Arizona State University, F Wing 550 E. Tyler Mall, Rm. 630, Tempe, AZ 85281, anbar@asu.edu.

Mastery of the peculiar and powerful practices of science is increasingly important for the average citizen. With the rise of the Internet, most of human knowledge is at our fingertips. As content becomes a commodity, success and survival aren't about who knows the most, but who is better able to explore the unknown, actively applying and extending knowledge through critical thinking and hypothesis-driven problem solving.

Unfortunately, science is too often taught as an encyclopedic collection of settled facts to be mastered rather than as a process of exploration that embraces curiosity, inquiry, testing, and communication to reduce uncertainty about the unknown. This problem is exacerbated by the continued prevalence of lecture-centric pedagogy, which promotes learning-from-authority, passive learning, and disciplinary silos. More effective "active learning" pedagogical approaches are well-known and researched [1], but are not available widely and difficult to scale [2].

Arizona State University's Education Through eXploration (ETX) Center aims to change the practice of teaching and learning by articulating and advancing a novel approach to active learning: teaching through exploration of the unknown, rather than through mastery of what is known, centered on authentic transdisciplinary questions rather than disciplines, and teaching learners the authentic practices of science. We call this philosophy "Education Through eXploration" – or **ETX**.

To attain scale, the learning experiences of the ETX Center are developed and deployed using digital platforms that enable engaging, adaptive, and transdisciplinary learning, to educate-through-exploration effectively and at scale. These platforms also make it possible to observe and analyze the behaviors of learners in rich detail, providing powerful new insights for learning research and evaluation.

NASA Science Mission Directorate's (SMD) exploration and compelling science questions provide rich content and context for engaging individual curiosity and pushing the boundaries of the unknown. Recently, ASU was selected as an education partner to NASA SMD and the ETX Center is at the heart of a new ASU-centered team, jointly led by Principal Investigator L. T. Elkins-Tanton, Director of the ASU School of Earth and Space Exploration and Deputy Principal Investigator, Ariel Anbar, Director of the ASU ETX Center. Our ASU Team will capitalize on the ETX Center's adaptive learning platform, their

Inspark Science Network, and Immersive Virtual Field Trip (iVFT) expertise.

To this end, ASU's NASA SMD Education Team will work with NASA subject matter experts (SMEs) and internal/external partners to develop and distribute next-generation digital learning experiences that are infused with NASA science content. Audiences will include: *near term*: independent self-learners, whom we will reach through museums, libraries, and after-school programs; *longer term*: the network will expand to K-12 in concert with NASA's development of new K-12 engagement strategies.

**The Inspark Science Network**, led by Smart Sparrow CEO and ASU Professor of Practice Ben-Naim (an Australian ed-tech start-up pioneering adaptive and personalized learning technology) and ASU, is a "teaching network" – a digitally powered community of educators creating and sharing next-generation courseware and technology. Inspark educators can develop and disseminate innovative online courseware and courseware modules using the Smart Sparrow *Adaptive eLearning Platform* that includes interactive simulations, virtual field trips, gamified elements, rapid adaptive feedback, intelligent tutoring systems, and personalized pathways that motivate and enhance learning. Through lab-like projects and tutorials, learners should be able to construct knowledge from interactive experiences, modeling the authentic practice of science while mastering complex concepts.

The Inspark Science Network architecture was previously developed by Smart Sparrow for the Biomedical Skills and Training Network (BEST; see <http://best.edu.au>). This architecture allows networked educators to find, create, modify, and share interactive learning modules. It also provides analytics visualizations that permit educators to rapidly identify weak points in their online lessons.

At present, the Inspark Science Network focuses on the postsecondary success of disadvantaged and low-income students in entry-level science, following the priorities of the Bill and Melinda Gates Foundation that is supporting the creation of this network. To this end, it presently consists of educators at community colleges and public research universities who teach entry-level college science courses. Through the funding provided by NASA SMD, the Inspark Science Network will be opened to SMD-aligned SMEs and educators teaching elsewhere in K-14.

**Immersive Virtual Field Trips** are topic-based, educationally rich experiences that are captured during

real expeditions with scientists doing current research. The iVFT portfolio will be expanded beyond the current content to include spacecraft and human-bound NASA-driven destinations. SMD iVFTs will enable learners to experience the process of science and wrestle with the same questions and evidence that NASA researchers encounter during their probing of the unknown... whether they are planetary analogs here on Earth or more distant destinations off-planet.

As we stumble into an unknown future increasingly of our own creation, we need more humans to be self-conscious problem-solvers rather than “algorithm-appliers” or “fact regurgitators”. Ultimately, our aim is to promote societal transformation at global scale through participatory, individualized exploration. Using transformational, accessible technological tools and networks can change the practice of teaching and learning especially when catalyzed by NASA’s exploration of the unknown.

**References:**

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- [2] Davis M. R. (2016) Adaptive Digital Curricula Lagging in Science, Social Studies, *EdWeek*, Vol. 35, Issue 17, Page s11.