A. Project Summary

We propose to develop a network of sites focused on identifying pedagogical challenges, developing new interactive learning materials, building advanced computational libraries and designing user-friendly and device-agnostic interfaces to enhance the teaching and learning of probability modeling and distributional thinking. By extending the work of successful NSF projects, e.g., Probability *Distributome* Project, and the computational and educational resources previously developed, we will introduce a framework for exploring, discovering and interacting with varieties of probability distributions. The network will forge technological advances, and build sustainable digital libraries integrated with an effective dissemination and professional development infrastructure to ensure on-going use and community support. There are several **novel features** of this proposal. This resource will build the infrastructure for community-based development, expansion and validation of the distributions' meta-data, computational libraries, and learning activities will be stored, processed, searched, traversed and updated by experts and educators. The *consortium* will provide a graphical user interfaces for interactive exploration of diverse distribution resources, as well as a web-service for query, discovery and computational utilization of these distribution resources by other software programs and tools. The *infrastructure* will be assembled under a guiding pedagogical learning model that fosters concept retention by providing a native example an external example and active practice with each clearly delineated learning objective.

Specifically, we will provide an open (development and utilization), device-agnostic, extensible and broad framework for learning, teaching, navigation, discovery and usage of probability distributions in diverse educational settings and scientific applications. The entire framework will be built using XML, HTML5, Wiki, MathML, MathJax, and LaTeX and will be freely made available to the entire community via www.*Distributome*.org. The **user-base** of the *Distributome* infrastructure will include both *educators* (integrating these graphical tools and instructional materials in their course curricula and participating in a unique virtual community led by a cadre of activists) and most importantly *learners* (exploring, validating and understanding the use of probability distributions and models for practical problem solving). Probability modeling is at the root of solving driving biological, engineering, health, physical science, and social problems fundamental to the modern STEM curriculum. The infrastructure of the National Probability Education Network will enable representation, demonstration, computation and visualization of a large number of probability distributions, their interrelations and their applications integrated with associated class and out-of-class activities to advance learning.

Our broad-based dissemination plan includes communication with all mathematical science departments, conference presentations, regular webinars, journal and newsletter publications, and connections to national professional and digital library organizations. Monthly webinars, annual instructor training events, and continuous networking workshops will engage the community in this effort and recruit activists to sustain efforts at creating, editing and reviewing these resources. The **evaluation** of the project draws on the efforts of an independent evaluation team as well as the experiences of the investigators. It includes pilot testing in N courses at K institutions, student-learning assessments, user volume/demographics, frequency/complexity of user feedback, qualitatively examined interactions with students and instructors, as well as quantitative evaluations of controlled experimental studies, participant surveys and expert critique.

The **intellectual merit** of this collaborative project lies in directly targeting the enhancement of distributional and probabilistic thinking and literacy – crucial reasoning skills that often create roadblocks to student success in multiple STEM disciplines. This intellectual merit is then achieved by multiple factors. The rigorous study of distribution modeling methods, concepts, applications and computations in diverse settings, integrated under a documented model to foster concept learning and retention, and the use of new information technologies to traverse, manage, graphically visualize and integrate this knowledge in quantitative educational curricula.

The project will have **broad impact** due to the rapidly expanding number of courses requiring methods for actively teaching core STEM content (hundreds of thousands of students in courses with probability content and tens of thousands in courses with probability modeling as a major focus). Furthermore, the open, portable and dynamic infrastructure will serve as a development model for other STEM disciplines, for motivating traditionally challenging learning concepts and for advancement of blended education.