Early Childhood STEM Lab at East Tennessee State University will partner with the School of Library and Information Studies at the University of Alabama to lead the proposed LB21 project (LB21-Goal 1. Objective 1.3), *Libraries Count: Co-Developing a Professional Learning Program to Build Capacity of Library Staff to Support Diverse Young Children and their Families in Math*, a 3-year Applied Research project. The mixed-methods research will evaluate the design process and impacts on early math knowledge and capacity building for library staff and families. Budget: $457,617.

Project Justification. Math skills and knowledge upon entry to kindergarten strongly predict young children's educational trajectories, even into high school [1]. The pandemic has disproportionately impacted math learning and children from diverse backgrounds [2, 3]. We must counter the misconception that math is learned in classrooms starting in school because we know that math learning develops all the time, everywhere, starting at birth, especially in the context of families. Professional learning (i.e., professional development) could address misconceptions and expand math in libraries, but such programs are rare [4,5,6]. Adult anxiety related to doing math with children is another barrier [7, 8]. Our project will address these challenges by creating and evaluating an online professional learning program, *Libraries Count*, for library staff (target group) to integrate math into programming for diverse young children (ages 3-5) and their families (beneficiaries). Ultimately, our goal is to support children and families living in diverse underserved communities who need support the most, like in the rural Appalachian region and in urban areas (e.g., with large % Latinx population).

Existing early library-based professional learning programs focus on early literacy (e.g., SuperCharged Storytimes), or school readiness broadly (e.g., ReImagining School Readiness), but none focus on math specifically with young children and their families. Our interdisciplinary team will (**objective 1**) co-develop the program with key stakeholders from a culturally-responsive, strengths-based perspective in diverse settings; (**objective 2**) pilot, evaluate, and iteratively improve the program in 2 states, TN and AL; and (**objective 3**) roll out and evaluate the impacts of the program at scale through WebJunction across our 2 pilot and 8 additional states (that include AZ, CA, CO, MA, ME, MD, NJ, NY). The research component will also produce new knowledge about the effectiveness of the co-development process, how well the *Libraries Count* program builds the capacity of library staff and families in supporting early math.

Project Results. Libraries Count. *Focus.* The online professional learning program will build the capacity of the library staff by increasing their knowledge about what early math is and how it develops, how language, literacy, and math are linked [9], and their confidence in supporting early math within programming, and to support diverse families to feel confident with math at home. We will build on strengths-based approaches to early math with families (e.g., Family Math Movement), IMLS-funded projects mentioned above, and existing research [6]. *Content*: We will work with our team of families, library staff, and content experts/researchers to co-create the content and format in the first year, with the extensive existing evidence-based early math resources as a guide (e.g., Khan Academy; Bedtime Math; DREME Network). Initial plans include modules focused on major domains of math, such as number and geometry. Module structure may include an overview of what early math is, how it develops, and how it relates to early literacy and language (e.g., [10]), with examples grounded in children's literature (e.g., spatial reasoning in the book *There's a Bear on my Chair*), tips for supporting children's and families' math thinking, doing, talking, and reading within libraries (e.g., number composition with toy bears and chairs), practical ideas to infuse early math content into current library programming (e.g., family math nights), and links to free resources (e.g., book, non-book activities; virtual learning tools).

Project Work Plan. The PI will apply for IRB approval through ETSU's IRB board prior to beginning the proposed project. The collaborators will meet in the first 6 months to identify strengths, form teams (e.g., Diversity, Equity, Inclusion, or DEI team), co-create the structure for the training and initial modules, formalize plans for TN and AL pilot, conduct expert content review, and collect initial data. In the second 6 months of year 1, we will pilot our initial training modules with libraries in TN and AL. We will make modifications based on results, create new modules, and plan to roll out revised modules to our expanded network of libraries across the country. Year 2 will focus on a cycle of piloting and revising the modules with library partners and diverse families at national partner sites. By the end of year 2, we will have the full training modules revised based on formative feedback. In year 3, library staff at partner sites across the United States will participate in the full training and complete pre-and post-assessments and surveys to assess impact. In the last 6 months of the proposed project, we will make final revisions to the program, complete dissemination efforts of research findings, and prepare to publish the training modules for free on WebJunction. Across all years, we will disseminate what we learn, continually evaluate our progress and revise as needed through feedback surveys and Advisory Board input (Performance Measurement Plan).

Research Questions

1. To what extent does a collaborative, co-development process between diverse families, library staff, and content experts/researchers empower collaborators and result in the creation of an adaptable and culturally-responsive professional learning program? (**objective 1**)
2. How do diverse families and library staff view the *Libraries Count* program in terms of its applicability to their own lives, relevance to their context, and the extent to which it is culturally responsive? (**objective 1**)

3. What impact does the *Libraries Count* program have in increasing library staff's knowledge about a) early math content, development, and learning, b) ways to engage diverse families in early math, and c) ways to include early math in library programming? (**objective 2-3**)
4. What impact does the *Libraries Count* program have in positively influencing library staffs' attitudes, beliefs, and confidence in supporting early math in young children and in their work with diverse families? (**objective 2-3**)

Methods

Theoretical framing. The 5Rs framework [3]; Ideabook) of family and community engagement, our evidence-based approach to professional learning [11], and research and resources on early math development (e.g., learning trajectories) and math with families (e.g., Young Mathematicians) guide our collaborative work. The 5Rs [3] and our emphasis on community engagement and social justice will frame progressive changes to meet underserved needs [12,13,14,15]. We will build on prior IMLS-funded projects, such as ReImagining School Readiness by diving into one critical domain in STEM (math) to build deep understanding through transformative and well-designed virtual professional learning. Our Webjunction partners are well-versed in instructional design for online learning.

*Design & Analysis Plan***.** We will use a convergent mixed methods research design [16] as we collect qualitative and quantitative data simultaneously across the life of the project and analyze merged data to answer our RQs. Examples of data include minutes (qual) from planning and co-development meetings and focus group feedback (qual) to answer RQ1, feedback data on perceptions of the tools (qual) for library staff and families (RQ2), pre-and post-training measures of knowledge of professional learning content (quant) and measures of self-efficacy in supporting early math and families (quant and qual) when we pilot and roll out the modules with library staff to assess the effectiveness of the training supports (RQs3&4). Data analysis approaches will match the data type (e.g., RQ4, paired samples *t*-test). Assessments with evidence of reliability and validity will be identified (e.g., KMD, [17]) and created (e.g., feedback survey) in the first 6 months of the project. The PI has extensive research experience and is well-versed in issues related to assessment psychometrics, data collection, analysis, and human subjects protection. *Data Measurement Plan.* We will conduct an evaluation throughout and ensure that we are following appropriate data management and privacy policies.

Partners/Team. *Leadership*: PI. Alissa A. Lange, Ph.D. Assoc. Professor in Early Childhood Education, Director of the EC STEM Lab, creator of MASST, Family Math Practice Network member, PI of early math and STEM projects, ETSU. Co-PI. Bharat Mehra, Ph.D. Professor & EBSCO Endowed Chair in Social Justice, School of Library and Information Studies, University of Alabama, PI on several IMLS grants in the Appalachian region involving training and rural libraries. Senior Personnel. Carol Trivette, Ph.D., expert in family engagement, ETSU. *Development Team*: Library staff & families in partner states. *Advisory Board.* Kate Green Smith, Youth Services and Special Projects Coordinator, TN State Library and Archives. Margaret Caspe, Ph.D., expert in family engagement with libraries and communities; Mega Subramaniam, Ph.D from UMD, experienced in learning environments in libraries; Jessica Young and Kristen Reed, Ph.D., experts in family math at Young Mathematicians at EDC; Hannah Lakin, STEM Education Specialist in informal learning, MMSA; Doug Clements, Ph.D. world-renowned early math expert, U of Denver. *Instructional design & hosting*. WebJunction will support the instructional design of the online program and hosting the completed program.

Broad Impact & Partners for Dissemination. Libraries and library systems across 10 states have agreed to co-develop, pilot, and disseminate the program. The Association of Rural and Small Libraries (ARSL) and the Collaborative Summer Library Program have agreed to help disseminate through through their listservs, and we will promote using our collaborators' platforms, such as ConnectedLib (Subramaniam), Young Mathematicians (EDC), and EC STEM Lab (Lange). Given the focus on children's programming, the *Libraries Count* project team would continue conversations with the Association for Library Service to Children (ALSC), with the goal of information sharing across their network as well. *Libraries Count* will be free through Webjunction, and research results will be published in multiple outlets each year to reach a broad audience, including library researchers, practitioners, and families.

Diversity Plan. Our work will be guided by principles of strengths-based and social justice lenses [18,19,20,13], grounded in the belief that we all have strengths and we must include all voices in this work. Members of the DEI team will contribute to program development and revision, ensuring that our program will be relevant for library staff, families, and children, and that our program will be flexible to work in diverse contexts. We will build on the project team's past work around early math and professional learning (Lange, Clements), training with libraries in rural communities (Mehra, Lakin, Subramaniam), and reaching families from diverse backgrounds (Lange, Mehra, Caspe, Trivette). All team members are chosen to help the program meet diverse underrepresented needs of communities across the country.

Budget Summary. Direct costs: (1) ETSU Salaries-faculty (Lange & Trivette)=$55,791, staff (Ridley)=$7,723; (2) Fringe=$32,822, (3) Travel=$6,000;(4) Supplies (printing & transcription)=$1,350; (5) Subaward (Mehra, co-PI)=$103,797 (6) Doctoral fellow, GA (stipend & tuition)=$33,639; (7) Other costs (Webjunction hosting, consultants)= $96,000; (8) Total direct costs=$337,123; (9) Indirect costs=$120,494 (10) **Total project costs=$457,617.**