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**CENTER FOR ADVANCED LANGUAGE PROFICIENCY EDUCATION AND RESEARCH**

**The Pennsylvania State University The University of Texas at San Antonio**

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# PLAN OF OPERATION

* 1. **Design of Project.** Since its inception in 2002, the Center for Advanced Language Proficiency Education and Research (CALPER) has focused on the development of high-quality instructional materials as well as teaching and assessment strategies designed to promote advanced levels of proficiency, in both less commonly taught languages (LCTLs) like Arabic, Korean, Russian and more commonly taught languages like Spanish and German. A defining feature of CALPER is that its projects are informed by cutting-edge research on the learning and teaching of languages as well as current theories of second language (L2) learning and teaching (e.g., Kim et al., 2018; Lantolf & Poehner, 2011). In the current proposal, we significantly extend CALPER’s twenty- year track record in at least three ways. First, our ten new language teaching and learning projects are conceptualized and framed in principles of Usage-Based Language Instruction (UBLI), an evidence-based approach to language teaching sensitive to features of the learning context itself and the experiences and prior language knowledge that learners bring to the classroom (McManus, 2022a; see also McManus, 2019, 2021; Tyler & Ortega, 2018; Verspoor & Nguyen, 2015). Second, all CALPER’s resources and events will be openly available and easily accessible through our well-established online presence (e.g., social media, membership lists, website) and online repositories tailored for specific language learning and teaching communities (e.g., CLTNet for teachers of Chinese in Pennsylvania). As a result, CALPER contributes significantly not only to promoting equity in access to educational resources and opportunities, but also to fostering and encouraging broader participation in open-access and open scholarship initiatives to expand and facilitate dialogue between research and pedagogy (Marsden et al., 2019; Sato et al., 2021). Third, we expand CALPER into a consortium relationship with the University of Texas at San Antonio (UTSA), a Minority-Serving Institution

(MSI) located in the second largest city in the Southern US. In these ways, the current proposal extends CALPER as a critical resource for improving the Nation’s capacity for teaching and learning foreign languages, especially LCTLs.

In framing CALPER’s work within UBLI, we advocate for an approach to language teaching that is informed by and based on how we learn, developed from decades of research in cognitive science, education, linguistics, psychology, and many other disciplines (Bybee, 2010; Christiansen & Chater, 2016; Tomasello, 2006). Indeed, this cross-disciplinary approach to the development of knowledge and advancement of theory and practice is widely considered to be a key strength of the usage-based program. One repeated and seminal observation from this body of work is that we learn language in the same ways that we learn any other ability. This is one reason why usage-based accounts of learning are sensitive to the ways in which general cognitive mechanisms (e.g., analogy, categorization, memory) can shape the learning and use of language (for reviews, see Ellis, 2006; MacWhinney, 2008; McManus, 2022a). By taking a UBLI approach to improving the teaching and learning of foreign languages, CALPER’s projects are designed and implemented using “pedagogical techniques that are sensitive to the prior knowledge and experiences of learners” (McManus, 2022a, p.90), which can be achieved “by using the insights about learning difficulties as evidenced in empirical research studies to inform the design of teaching materials and approaches to instruction” (ibid., p. 130). This means that we use actual evidence about how speakers learn and use their languages to inform language instruction, rather than using broad generalizations about how we think learning and use ought to happen. In the 2018-2022 cycle, for example, CALPER project coordinators McManus and Furniss each used research evidence derived from corpus data of language use and L2 learning to develop teacher resources about first language (L1) use in the classroom (e.g., McManus, 2018,

2022b) and instructional modules for vocabulary instruction (e.g., Kisselev & Furniss, 2020), both of which have attracted considerable interest from the language teaching community.

In the current cycle, we build on this work by systematically applying four principles of UBLI to the design and development of instructional materials and teaching strategies in CALPER’s ten projects, as follows: (1) teachers and students prioritize communication and meaning during comprehension and production activities, (2) language use and language learning take place in contextualized social interactions, (3) high-quality conceptual knowledge/awareness of the target language and other languages as well as authentic materials are used to promote comprehension and production, (4) instructional materials, curricula, and professional development (PD) units are constructed from collections of actual language use with examples.

Each project will incorporate one or more of these four principles for effective classroom interaction, the development and implementation of materials, and curriculum design. For example, Project 1 (Language Use in World Languages Classrooms) incorporates UBLI principles 2, 3, and 4 by using recordings of actual classroom interactions as a foundation for creating PD units for teachers. Here, our aim is to trigger and develop high-quality conceptual knowledge and awareness of strategies for effective target language use known to be essential for L2 learning. UBLI principle 1 is forefronted in Project 4 on Arabic pronunciation. In this project, L2 speakers use the target language to complete a series of meaning-focused tasks and interactions (e.g., narrate short stories, participate in discussions about their lives) to generate rich instances of language use, which are then used to inform the creation of pedagogical units (UBLI principle 4) to target some of the most difficult pronunciation features for English- speaking learners of Arabic. Designing augmented reality (AR) and virtual reality (VR)

pedagogical tools for Chinese, Bambara, Korean, and Portuguese (Projects 6 and 7) involves the use of authentic materials (UBLI principle 3) that situate learners and teachers in highly contextualized social interactions (UBLI principle 2) to achieve and support L2 development.

In sum, the current proposal significantly extends CALPER’s twenty-year track record in improving the Nation’s capacity for teaching and learning LCTLs by designing and creating instructional materials and PD units guided by four UBLI principles. Our resources will be evidence-based and informed by cutting-edge research on language learning and teaching. In addition, all resources will be openly available and easily accessible, thus helping to promote equity in access to educational resources and opportunities and facilitating dialogue between research and pedagogy.

* 1. **Management Plan.** The proposal establishes Penn State as the primary unit and UTSA as the secondary (i.e., subcontracted) unit for CALPER. The management plan is therefore designed to ensure the efficient and effective operation of this dual-site structure. The director (McManus) and the associate director (Wang) are located at Penn State. The co-director (Kisselev) is located at UTSA. Each site already has in place the appropriate support staff provided by the relevant institution. Each individual project is headed up by a coordinator (or coordinators) responsible for the day-to-conduct of each project.

Kevin McManus (Director of the Center for Language Acquisition, Gilbert R.Watz Early Career Professor in Language and Linguistics, and Associate Professor of Applied Linguistics at Penn State) will serve as overall director of CALPER. Olesya Kisselev (Assistant Professor of Applied Linguistics at UTSA) will serve as co-director of CALPER. Jialing Wang (Research Technologist in the Center for Language Acquisition at Penn State) will serve as associate director of CALPER.

The director, co-director, and associate director will serve as CALPER’s core management team (CMT) responsible for the daily operation of this Language Resource Center (LRC), including budget and personnel matters, and will ensure that all projects remain on schedule to meet CALPER’s aims and objectives (see also Evaluation Plan). Project coordinators will submit to the CMT semi-annual and annual reports on each project’s progress to date. The CMT will be supplemented by an external Evaluation Panel (EP) comprised of two world- renowned scholars and educators with considerable expertise in the work of the LRC program, CALPER’s ten projects in language learning and teaching, program review and management, and methods and techniques of quantitative data analysis: Victoria Hasko (Associate Professor, University of Georgia) and Luke Plonsky (Associate Professor, Northern Arizona University).

The EP will receive yearly reports on the status of each project that will describe activity to date, materials created and developed, and dissemination activities conducted. The EP will meet together first and then annually with CALPER’s CMT (in person in years 1 and 4, via videoconference in years 2 and 3). The EP will provide the necessary feedback and recommendations to ensure the timeline and goals of each individual project are met. Hasko and Plonsky have agreed to serve as EP members for the duration of the project (see Appendix 3: Letters of support).

**Management plan summary:** The daily operation of CALPER, including monitoring of projects for progress and timeline compliance, budget oversight, dissemination, and outreach will be managed by the director in conjunction with the CMT. The EP will receive and evaluate yearly reports on all CALPER projects. The CMT and the EP will meet annually (in person and via videoconference) to review the progress and quality of each project. Together, the CMT and the EP will assess CALPER’s performance relative to its objectives and purpose.

* 1. **Center Objectives and Purpose.** For twenty years now, CALPER has energetically sought to develop and disseminate instructional materials and practices to significantly enhance the Nation’s capacity to engage in effective foreign language instruction, including LCTLs, at institutions that traditionally serve underrepresented students. Our specific goals relate to materials and practices that promote advanced language proficiency in the US (as defined on the ACTFL scale). CALPER’s main objectives are as follows:
     1. Design and create high-quality instructional materials and PD units to support and maximize the development of advanced language proficiencies in LTCLs. These resources will be grounded in principles of UBLI (see section 1.a). Each project’s objectives (see section 1.d.) are linked to at least one of these UBLI principles.
     2. Create and widely disseminate instructional materials and PD units directly based on research evidence (e.g., corpus data) about how speakers actually use language. By making our resources openly available and easily accessible, CALPER works toward facilitating dialogue between research and pedagogy in world language education as well as promoting equity in access to educational resources and opportunities. Indeed, the lack of openness and accessibility of research and teaching resources is known to constitute a critical impediment to innovation and improvement in language pedagogy (Marsden et al., 2019).
  2. **Plan to Achieve Objectives.** The proposed projects realize CALPER’s goals and fully adhere to the program’s Absolute Priority by focusing exclusively on the learning and teaching of LCTLs. For each project, we give its working title, coordinator(s), objectives, compliance with the Absolute and Competitive Preference Priorities, and a description of materials and activities.
     1. LANGUAGE USE IN WORLD LANGUAGES CLASSROOMS. *Coordinator:* Kevin McManus (Penn

State). *Objectives:* (i) document language use in LCTL classrooms, with a primary focus on how

teachers use the target and other languages; (ii) create teacher resources and a guide of best practices for language use in LCTL classrooms. *UBLI objectives:* (2) language use and language learning take place in contextualized social interactions, (3) high-quality conceptual knowledge/awareness of the target language and other languages is used to promote comprehension and production, (4) instructional materials, curricula, and PD units are constructed from collections of actual language use with examples. *Absolute Priority:* The project involves Arabic, Korean, and Russian. McManus will dedicate 10% time to the project.

Input, or exposure to language, plays a fundamental role in language learning. Indeed, this is one reason why nearly all accounts of L2 learning and teaching assign some role to input (e.g., Gass et al., 2020; VanPatten, 2017). Despite this understanding, however, very little is currently understood about what the input in classroom contexts looks like, including the types and functions of language typically available in world language classrooms (Huensch, 2019a; McManus & Bluemel, 2022). This is especially the case for LCTLs like Arabic, Korean, and Russian (for reviews, see Cho, 2021; Dengub et al., 2020).

Addressing this gap is important for at least three reasons. First, inadequate knowledge about how languages are used in world language classrooms limits progress towards improving the quality of language teaching and developing effective and engaging curricula and lessons for the development of advanced language proficiency. Studies of language use generated from generalist corpora (e.g., *el corpus del español*, Davies 2022) cannot adequately represent what language use in world language classrooms looks like because they are compiled from a variety of sources and genres, including newspaper articles, academic publications, TV and radio content. As a result, insights about how language is likely used in the classroom informed by generalist language corpora presents a biased and unrepresentative perspective. Second, by

understanding how language teachers use the target language and other languages (e.g., L1) in the classroom, evidence-based recommendations for teacher training and curriculum development can be provided to maximize learning potential in these contexts. Indeed, this is one motivation behind ACTFL’s “going for 90% plus” which aims to increase the amount of target language use in the classroom. However, as is well-known, quantity is an insufficient yardstick for the development of advanced language proficiency. Attention must also be paid to the quality (or functions) of language use. Third, by more fully documenting what types of language are used in classrooms, better informed decisions can be made about curricular content and syllabus designs. For example, some studies suggest that very frequent target features should not be prioritized in the classroom (see VanPatten, 2017), but without evidence about what those very frequent features are in these specific contexts, very little progress can be made to support language instructors in the development of high-quality pedagogical materials.

To address these gaps and improve the Nation’s capacity for language teaching and learning, this four-year project will document teachers’ language use (target, L1, and other languages) in LCTL classrooms. Informed by this evidence base, the project will (i) create openly available and easily accessible resources about actual language use in world language classrooms usable by teachers, teacher educators, and learners, (ii) develop evidence-based teaching materials and best practices for language use in LCTL classrooms, and (iii) widely disseminate these products and activities throughout the Nation.

*Project activities.* Teachers’ use of different languages in Arabic, Korean, and Russian foreign language classrooms will be documented using video and audio recordings, which will then be orthographically transcribed and analyzed (following accepted protocols in applied linguistics research, see MacWhinney, 2000). Classroom transcripts will be made available and

accessible to researchers and teachers on the CALPER website and will be used in the development of PD workshops and webinars. This follows the successful model used by McManus and colleagues in the open sharing of language data that has been used to inform language teaching and PD, see <http://langsnap.soton.ac.uk/>

In terms of the content of the classroom corpus, each language grouping (e.g., Arabic classrooms) will include video and audio recordings from three different levels of post-secondary instruction (elementary 1, elementary 2, and intermediate 1) at three points in time (semester beginning, middle, and end). Four classes will be recruited per language and per level. For example, four Arabic classes in elementary 1, four in elementary 2, and four in intermediate 1.

This will result in a language classroom corpus of 78 classroom observations, across three languages, and three levels of instruction. No comparable corpus exists.

This project includes the following key milestones:

Year 1: Develop observation and recording protocols from research on similar topics (e.g., Collins et al., 2012; McManus & Bluemel, 2022); Submit IRB to perform research activities; Pilot-test recordings and observations with comparable world language classrooms (e.g., Chinese); Recruit teachers and classes to project.

Year 2: Begin data collection; Begin transcription and analysis of observations and recordings; Explore options for creating open repository to publicly share corpus.

Year 3: Complete collection, transcription, and analysis of all classroom data; Upload and (soft-)launch repository of open repository classroom data; Begin dissemination (e.g., ACTFL, NCOLCTL, CALPER workshops).

Year 4: Full launch of open repository; Publication of teacher guides; Dissemination.

* + 1. Literacy instruction to support advanced proficiency in hl russian. *Coordinator*:

Olesya Kisselev (UTSA). *Objectives:* (i) document and describe relationships between orthographic knowledge (a functional ability to spell words) and proficiency among heritage language (HL) learners of Russian; (ii) develop an instructional approach that focuses on developing literacy skills in HL learners in conjunction with an awareness of phonology, morphology, and morphological structure. *UBLI objectives:* (1) teachers and students prioritize communication and meaning during comprehension and production activities, (3) high-quality conceptual knowledge/awareness of the target language and other languages is used to promote comprehension and production, (4) instructional materials, curricula, and PD units are constructed from collections of actual language use with examples. *Absolute Priority:* The project involves Russian. *Competitive Priority*: This project will be implemented by UTSA. Kisselev will dedicate 10% time to the project.

In recent years, the US government has recognized HLs as a valuable resource in fostering expertise in world languages and cultures (Rivers & Brecht, 2018). Yet, despite growing support for HLs, institutionalized efforts designed to maintain and strategically develop the linguistic abilities of HL speakers are extremely limited (Shin, 2003). As a result, HL speakers rarely develop language abilities beyond intermediate proficiency, understood to be insufficient for professional purposes and intergenerational transmission of the language.

An impressive body of research describing the linguistic skills of HL speakers has been accumulated in the past few decades (e.g., Kisselev & Alsufieva, 2017; Montrul, 2010, 2018; Polinsky, 1997, 2006). Much of this research unequivocally shows that HL speakers’ linguistic systems undergo a significant restructuring or “degradation” (Polinsky, 2011, p. 306), which is understood to prevent these speakers from attaining advanced language proficiency. In lieu of

explaining this restructuring, a new line of inquiry has begun to gain traction in the field, that of investigating the link between *literacy* (i.e., a functional ability to read and write in the language) and global development of language skills in HL speakers. Extending this new line of inquiry, the proposed project investigates a specific component of literacy: spelling and orthography, and the relationship between spelling/orthography and overall language proficiency in HL speakers.

Until recently, spelling was viewed as a trivial aspect of literacy development in HL (Baudrie, 2012; Llombart-Huesca, 2017). However, research on the acquisition of orthography from the field of child language development has highlighted orthography as a “foundation stone” in language development (Treiman & Kessler, 2014, p. 7). This fundamental aspect is inherently connected to such important linguistic skills as phonological and phonemic awareness, and understanding of morphological structures, which in turn constitute the foundation of structural knowledge of language (Llombart-Huesca, 2017). It has become apparent that the link between spelling abilities and overall language development is far from trivial, and that in the quest to educate future “global professionals”, it is important to recognize that a focus on literacy can play an invaluable role in helping HL speakers move beyond intermediate proficiency.

The goal of the proposed project is two-fold. First, it aims to empirically establish and describe the links between orthographic knowledge and proficiency level in Russian HL learners; secondly, the project will develop an instructional approach that focuses on developing literacy skills in HL learners in conjunction with developing awareness of phonology, morphology, and morphological structure.

Russian presents a unique ground for the outlined research inquiry: it is a language with an alphabet different from English, which makes casual transfer of literacy skills from English to Russian difficult, at best. With very few corresponding letter-sound combinations in this

language pairing, the investigation of phonemic and phonological knowledge reflected in spelling promises very straightforward results (Shafiro & Kharkhurin, 2009). Russian is also a highly inflectional language which uses morphology to signal number, gender, case, and tense/aspect features; many of the differences in the inflectional suffixes are barely or non- perceptible auditorily, a fact that is hypothesized to contribute to the development of an impoverished morphological system in HL Russian. It is hypothesized that both phonological and morphological challenges will be reflected in the (mis)spellings found in the data.

*Project activities.* This project includes the following key activities:

Year 1: Conduct interviews with US-based Russian HL teachers to determine the approaches used in teaching literacy to HL learners of Russian; Extract Russian HL data from the Russian Learner Corpus (Kisselev, Kopotev & Klimov, 2021); Annotate and code corpus data.

Year 2: Develop a taxonomy of misspelled words from corpus data; Analyze relationships among number and the types of misspelled words with proficiency levels.

Year 3: Create and pilot a novel teaching approach grounded in UBLI using the corpus evidence accumulated and analyzed in Years 1 and 2; Focus on areas of linguistic knowledge that HL learners struggle with the most; Build high-quality conceptual knowledge/awareness of the target features and utilize authentic materials and tasks.

Year 4: Workshops and conference presentations at national and regional language education events; Dissemination of exemplary PD units.

* + 1. Instructional materials for pragmatic and interactional competence in japanese.

*Coordinators*: Stephen Looney (Penn State), Akiko Imamura (Michigan State University), and

Innhwa Park (West Chester University). *Objectives:* (i) build a corpus of video-recorded and transcribed spoken interaction for use by L2 teachers and researchers; (ii) develop open access, online teaching materials for advanced L2 oral proficiency, pragmatics, and interactional competence in Japanese. *UBLI objectives*: (1) teachers and students prioritize communication and meaning during comprehension and production activities, (2) language use and language learning take place in contextualized social interactions, (4) instructional materials, curricula, and PD training units are constructed from collections of actual language use with examples.

*Absolute Priority:* The project includes a significant focus on Japanese. Looney will dedicate 10% time and Imamura and Park will each dedicate 5% time to the project.

The current project aims to create materials that align with ACTFL’s world-readiness standards for learning languages and will be informed by UBLI. To achieve this goal, the instructional materials start with social activity, the primordial site of human sociality, purpose of speaking, and locus of language learning (Pekarek Doehler & Eskildsen, 2022; Schegloff, 1996). This is because L2 learning is an inherently social undertaking. Interactants talk in turns and those turns incrementally accumulate into orderly sequences and courses of action. It is within these sequences that interactional contingencies arise making specific actions relevant or not. L2 development occurs in part when learners recognize specific actions and can map target L2 linguistic and nonverbal resources to actions. Learners’ interactional repertoires are constructed and refined through repeated situated activities such as but not limited to ordering food (Theodorsdottir, 2018), participating in classes (Hellermann, 2006), and engaging in word searches (Skogmyr Marian & Pekarek Doehler, 2022). Research on L2 development in interaction is plentiful, but there is a paucity of instructional materials informed by naturally occurring interaction. This project addresses that need.

The materials are composed of six units, each covering a specific type of social activity (e.g., making requests, telling jokes). Each activity is presented conceptually in terms of pragmatics and then concretely in terms of the actual sequence of actions. Each unit engages students in analysis of and reflection upon naturally occurring, video-recorded and transcribed interactions as well as participation in roleplays designed to simulate naturalistic interaction.

Each unit raises learners’ awareness of specific interactional features (i.e., sequences, linguistic resources, and embodied resources), associated with the activity on which the unit focuses.

Similar interventions have already been used to improve communication in professional settings (e.g., Stokoe, 2014). The proposed instructional materials are distinct, though, because they focus on foreign language proficiency.

*Project activities.* The following key activities are proposed:

Year 1: Develop protocol for data collection; Pilot-test data collection protocol; Begin collection and transcription of naturalistic conversational data from Japanese speakers living in the US.

Year 2: Begin coding and analysis of corpus data, by team members individually and in regular group data sessions held virtually.

Year 3: Create and design instructional materials based on corpus data; Pilot materials with teachers.

Year 4: Dissemination; Upload and develop open repository for sharing data and resources.

* + 1. ADVANCED PRONUNCIATION INSTRUCTION IN L2 ARABIC. *Coordinator*: Amanda Huensch

(University of Pittsburgh). *Objectives:* (i) assess the needs, attitudes, and current practices of LCTL instructors regarding pronunciation teaching and learning in the US; (ii) compile an oral

learner corpus to document pronunciation features in L2 Arabic (target- and nontarget-like); (iii) design and facilitate workshops to help LCTL instructors create effective pronunciation activities for use in LCTL classrooms. *UBLI objectives:* (1) teachers and students prioritize communication and meaning during comprehension and production activities, (3) high-quality conceptual knowledge/awareness of the target language and other languages as well as authentic materials are used to promote comprehension and production, (4) instructional materials, curricula, and PD units are constructed from collections of actual language use with examples.

*Absolute Priority:* The project involves Arabic. Huensch will dedicate 10% time to the project.

Even though pronunciation is a critical skill required for effective communication and advanced L2 development, research has repeatedly shown that pronunciation is still an often- neglected skill in world language classrooms (Darcy, 2018; Huensch, 2019b). This situation is particularly problematic because learning new pronunciation features can be incredibly difficult (especially for features that are different in L1 and L2). Indeed, many pronunciation features require pedagogical intervention since they rarely emerge from exposure alone.

In terms of understanding why pronunciation instruction appears rare in world language classrooms, research involving instructors of commonly taught languages (e.g., French, German) indicates that teachers lack adequate training about how to teach speech and are unaware of existing materials specifically designed for teaching pronunciation (Buss, 2016; Foote et al., 2011; Huensch, 2018a). At the same time, this research indicates considerable frustration among teachers because pronunciation is a skill that is highly valued in the classroom, by teachers and learners alike. Given that very little is currently known about the teaching practices, materials availability, or attitudes toward pronunciation instruction in LCTL classrooms, it is very likely that this situation is exacerbated by the fact that even fewer resources typically exist for such

languages. Using an evidence-based approach, this project addresses these critical needs in world language instruction by developing effective pronunciation teaching materials to support advanced language development in L2 Arabic.

To achieve this goal, the project will (1) assess the needs, attitudes, and current practices of instructors regarding pronunciation teaching and learning, (2) compile an oral learner corpus to better understand potential patterns of (non)target-like usage of different pronunciation features, and (3) hold workshops designed to help instructors create pronunciation activities to incorporate into their existing lessons. The oral learner corpus will be comprised of spontaneous speech samples produced by learners at different proficiency levels. Following well-established methods developed in the field of L2 pronunciation and assessment (O’Brien et al., 2018; Saito et al., 2017) and aligning with activities normally completed in classrooms, the speech samples will be comprised of picture story narrations and responses to open-ended questions related to the learners’ everyday lives. Very few L2 Arabic corpora exist, and of those that do, only one includes oral speech samples. The Arabic Learner Corpus (Alfaifi & Atwell, 2015) contains speech samples, but they represent a very small portion of the corpus (7%) and most of the speakers come from non-English L1 backgrounds. To develop appropriate pronunciation materials for English L1 speakers, speech data is needed from this population.

*Project activities.* The following main project activities are proposed:

Year 1: Develop and pilot national survey on the pronunciation beliefs and teaching practices of LCTL instructors, focusing on instructors of Arabic; Identify instructors via institution websites representing public universities with the greatest number of enrollments.

Year 2: Data collection and analysis of survey data; Creation and piloting of tasks/materials for the learner corpus.

Year 3: Creation of learner corpus, including transcription and coding of the speech files for pronunciation features; Planning of teacher training workshops.

Year 4: Hold teacher training workshops based on results from national survey and learner corpus findings; Create templates for pronunciation teaching with teachers to use in their own classrooms; Dissemination of corpus and teaching materials.

* + 1. TEACHER TRAINING IN CHINESE IMMERSION CLASSROOMS. *Coordinators*: Zhongfeng Tian and

Becky H. Huang (UTSA). *Objectives:* (i) determine the current needs of Chinese immersion teachers across the US, (ii) design specialized PD units to address the needs of Chinese immersion teachers informed by the needs analysis. *UBLI objective:* (3) high-quality conceptual knowledge/awareness of the target language and other languages is used to promote comprehension and production. *Absolute Priority:* The project includes a significant focus on Mandarin Chinese. *Competitive Priority*: This project will be implemented by UTSA. Tian will dedicate 10% time and Huang will dedicate 5% time to the project.

In recent years, the US has witnessed a rapid growth of Mandarin Chinese-English dual language immersion (DLI) programs offered in the K-12 sector (Lü, 2019) due to several factors, such as the rising economic and political power of the People’s Republic of China, the growing number of Chinese Americans, and increasing awareness on the part of ethnic Chinese parents for maintaining their heritage language and culture (Hsu, 2016). These programs usually provide content area instruction in two languages with a minimum of 50% instruction in Chinese (Howard et al., 2018), and have been hailed as an effective way to promote advanced proficiency

in Chinese language and literacy and high academic achievement compared to traditional foreign language and non-immersion programs (Xu et al., 2015; Fortune & Song, 2016). However, designing, implementing, and sustaining high-quality Mandarin-English DLI education presents unique sets of challenges. Most critically, there is inadequate teacher training for Chinese immersion programs (Sung & Tsai, 2019). Chinese immersion teachers “need specialized PD support to meet the complex task of concurrently addressing content, language and literacy development in an integrated, subject-matter-driven language program,” (Fortune, 2012, p. 12); they also need support in designing developmentally appropriate curriculum, materials, as well as in developing reliable and valid formative and summative assessments to measure learner growth. In addition, Chinese teachers also struggle with creating more learner-centered classroom environment because of their previous educational experiences in the more traditional, teacher-centered approach and the significant cultural differences between the US and their homeland (Chen et al., 2017).

The current project addresses this issue—the lack of teacher training among Chinese immersion teachers—to support and maintain the development of high-quality Mandarin-English DLI programs in the US.

*Project activities.* First, a needs analysis will be carried out using an online survey and conducting one-on-one interviews with focal Chinese teachers to gain both a comprehensive and an in-depth understanding of the current needs of Chinese immersion teachers across the US. Based on the results of this first phase, a series of specialized PD units will be designed that target and address Chinese immersion teachers’ needs from different dimensions, such as pedagogical techniques to promote advanced Chinese language and literacy proficiency, curriculum design and material development, and assessment. To increase accessibility, all PD

opportunities will be delivered virtually. The effectiveness of the PD workshops will be evaluated through collecting quantitative and qualitative data from teacher participants. The data sources for evaluation will draw from pre- and post-test teacher surveys, semi-structured teacher interviews, class observations and teachers’ artifacts. The ultimate goal of this project’s activities is to strengthen the teaching force in US Mandarin-English DLI programs via specialized and effective teacher training and PD. The following key activities are proposed:

Year 1: Design of surveys and development of interview protocols in three language versions (English, simplified, and traditional Chinese); Obtain IRB approval; Recruit schools and teachers; Conduct a content validity study and a pilot study to test surveys and interview protocols; Revise instruments based on the pilot results.

Year 2: Dissemination of surveys to Chinese immersion teachers across the US; Conduct preliminary quantitative data analysis of survey results; Select focal teacher participants for one-on-one interviews; Conduct interviews with focal teacher participants; Perform qualitative analysis of interview responses; Examine survey and interview results for teacher PD.

Year 3: Design specialized PD units based on the needs analysis results; Collaborate with technical specialists to design and deliver PD units.

Year 4: Deliver PD units to Chinese immersion teachers; Conduct data collection and analysis to determine effectiveness of PD units; Dissemination.

* + 1. Augmented reality for korean language and culture teaching. *Coordinator*:

Jayoung Song (Penn State). *Objectives:* (i) develop mobile-based, AR applications for teaching reading and culture to advanced learners of Korean and (ii) assess the effectiveness of these

instructional materials for the development of advanced language proficiency in L2 Korean. *UBLI objectives:* (1) teachers and students prioritize communication and meaning during comprehension and production activities, (2) language use and language learning take place in contextualized social interactions, (3) authentic materials are used to promote comprehension and production. *Absolute Priority:* The project involves Korean. Song will dedicate 10% time to this project.

According to the 2018 Modern Language Association report (Looney & Lusin, 2018), Korean is the only language that showed a sharp increase in enrollments over the past few years compared to other foreign languages. Despite this unprecedented growth, there are relatively few innovative Korean language and culture materials in the US and globally (Byon & Pyun, 2022; Godwin-Jones, 2013; Lyu, 2018). To address this situation, this project will develop high- quality, evidence-based instructional materials to support the teaching of advanced level Korean language and culture. These materials will also engage with recent technological advances to maximize engagement and continued interest and will be made freely available.

Studies have repeatedly shown that AR can provide learners with a mediated space, giving them a critical sense of being with others (Song, 2022). Such a sense of presence is understood to increase students’ knowledge and long-term memory retention, enhance motivation and attention, and provide access to authentic learning contexts for meaningful language learning (Carlson et al., 2016; Laine, 2018; Solak & Cakir, 2015). This mediated space and sense of being are expected to be particularly beneficial for Korean language learners in the US who have limited opportunities to visit Korea and access to authentic interactions and materials. Although there is a growing body of research on the pedagogical advantages of AR applications, there is very little empirical research on the specific effectiveness of these

technologies for the teaching and learning of foreign languages, especially Korean. More research and curriculum development is needed to investigate the far-reaching benefits of AR for improving language instruction.

The purpose of the project is twofold: 1) Develop mobile-based AR applications for the teaching of reading and culture for advanced Korean learners and 2) evaluate the effectiveness of these materials for the development of advanced language proficiency.

*Project activities.* This project will create a mystery-solving game-based learning app which takes place in Gyeongbok Palace in Korea, tentatively titled *The Secret Letter from Gyeongbok Palace*. This app will be used in advanced Korean classes to provide students with opportunities to learn Korean language and culture in an engaging and enriching way. Drawing on problem-based learning and game-based learning theories, the learning app will present Korean history and cultural artifacts with narrative-driven AR educational games. That is, instead of reading texts about Korean history, learners will be invited to solve problems (e.g., a murder mystery) to promote engagement and voluntary participation. Taking the role of an active problem solver is expected to make students immerse themselves more willingly in the problem- solving activity while engaging with reading and learning of Korean history. This learning experience will motivate the students to actively participate in their learning process and expand their educational opportunities.

This project will make practical and theoretical contributions to the existing Korean programs in distinct ways. First, the curriculum will benefit a significant number of students and teachers who are enrolled in advanced Korean programs nationally and globally. When the mobile-based AR app is developed, it will be publicly shared with instructional guidelines so that Korean language learners and teachers can use it in their learning and teaching. Theoretically,

this study will inform L2 researchers and curriculum developers of the possibilities of using AR for developing learners’ reading and cultural knowledge. The study will provide empirical evidence on whether and to what extent innovative technology can be used for language development.

The following key milestones are proposed.

Year 1: Conduct essential groundwork for development of the AR application, including site visits, storyboard making, and program development; Systematically review AR applications currently used in language teaching; Meet with stakeholders to understand the currents needs of Korean instructors in the US.

Year 2: Develop VR application and piloting of the application. Year 3: Data collection with classroom learners of Korean.

Year 4: Dissemination, including presentations at teacher educator conferences (e.g., AATK), workshops and webinars provided by CALPER, research publications.

* + 1. LANGUAGE INSTRUCTION USING IMMERSIVE TECHNOLOGY. *Coordinator*: Brody Bluemel

(Delaware State University). *Objectives:* (i) provide instructors with resources, guidance, and skills to adapt immersive technology for use in LCTL classrooms; (ii) develop a digital training guidebook for teachers on how to adapt immersive technology for language teaching and create instructional resources and materials; (iii) create modules of fully developed lesson plans using immersive technology. *UBLI objectives:* (1) teachers and students prioritize communication and meaning during comprehension and production activities, (2) language use and language learning take place in contextualized social interactions, (3) high-quality conceptual knowledge/awareness of the target language and other languages as well as authentic materials

are used to promote comprehension and production. *Absolute Priority:* The project involves Chinese, Bambara, and Portuguese. *Competitive Priority*: This project will be implemented by Delaware State University, an MSI. Bluemel will dedicate 10% time to this project.

This project seeks to establish an entry point for language educators in adopting the newest and most innovative immersive technology resources and techniques for language learning. Immersive technology for language education includes AR, VR, experiential learning in the metaverse, and other interactive digital tools. While use of immersive technology is an emerging trend, initial research has already demonstrated its efficacy in developing interactive communication; addressing topics of behaviors, affections, and beliefs; as well as in task-based instruction (Lin & Lan, 2015). Immersive technology allows educators to present all learners with experiential learning opportunities to use the target language by simulating real-world interactions, thus providing a more engaging experience for learners as they develop interactive communication skills in the target language.

Immersive technology has begun to be adapted innovatively for language education in recent years. As digital entrepreneurs are now pursuing the development of the metaverse and immersive platforms, it is evident that this technology will become an intricate aspect of education going forward. This project will provide the resources and training necessary for language educators to confidently implement this technology in their classrooms to provide a more immersive, interactive, and meaningful learning experience. There are numerous immersive technology resources that are readily available and that can be adopted to support language teaching. The project will provide a large variety of sample materials and resources, guide users on how to adapt these existing materials, and then outline the steps necessary to

independently develop learning activities with immersive technology. The resources developed for this project will be accessible to educators with all levels of technological skill and ability.

*Project activities.* The following activities are proposed:

Year 1: Identify expansive list of VR, AR, and metaverse platforms and resources, including

i) platforms developed specifically for language instruction, ii) additional applications that can be applied for language learning, iii) links to existing content (such as VR videos) in the languages/cultures identified for this project; Draft the interactive digital guidebook for language educators; Create one learning module sample lesson plan (with resources) with a focus on advanced proficiency communication skills in Chinese.

Year 2: Revise digital guidebook for language educators following feedback from language educators at Delaware State; Publish guidebook open access; Develop two additional sample lesson plans with resources in Chinese and Portuguese; Produce new immersive technology resource (specifically, additional VR content material (360 videos) will be recorded and shared open source).

Year 3: Create three additional sample lesson plans with resources, with a focus on advanced proficiency communication skills in Chinese, Bambara, and Portuguese; Produce two new immersive technology resources.

Year 4: Create three additional sample lesson plans with resources for Chinese, Bambara, and Portuguese; Create two new immersive technology resources.

* + 1. DISSEMINATION OF CALPER’S PEDAGOGICAL PRODUCTS. *Coordinators*: CMT. *Objective*: openly

and freely disseminate all project outcomes to language teaching professionals. The

dissemination strategies will include robust sets of workshops and webinars as well as in-person events at Penn State and UTSA. In year four, we will hold a conference on UBLI at Penn State for teachers and teacher educators, with live streaming for virtual participation.

Over the four-year period, projects 1-7 will each lead to at least two webinars for language educators about the project’s area and the pedagogical products developed from the project. For projects 1-4, 6-7, these webinars will first be for a general audience (e.g., general strategies for language use in world language classrooms) and then for a more language-focused or skill-focused audience (e.g., Japanese pragmatics, Arabic pronunciation). Other workshops will have a specific needs-based focus, including Project 4 (needs of LCTL instructors for pronunciation) and Project 5 (needs of DLI teachers and administrators). Workshops will be also scheduled as pre-conference sessions prior to the UBLI conference in year four. Following the successful model launched by McManus at Penn State (see section 7), each webinar will last at least two hours, will be free for participants to attend, and will be made freely available to the language teaching community after the event, including access to materials discussed during the webinar and access to PowerPoint slides. These will be housed on CALPER’s website, with postings on social media (Facebook, Twitter). Opportunities to interact with CALPER’s project coordinators after the event will be made possible via ‘Social Media Take Over’ events, whereby the webinar presenter takes over CALPER’s social media accounts for three hours to engage with users about their project.

We will additionally invite language educators who participate in webinars and events or who provide instruction on the relevant campus or campuses (Penn State, UTSA, Pittsburgh, Delaware State) to pilot the deliverables proposed by each project as they are in progress.

Teacher feedback will be used to modify the materials. Project coordinators will also submit

presentations to professional conferences (such as the various AATs and their regional affiliates, the Heritage Language Research Institute conducted by the NHLRC at UCLA, NCOLTCL as well as the UBLI conference sponsored by CALPER). We will also exhibit our materials and products at national (e.g., ACTFL), regional (e.g., NECTFL), and state (e.g., PSMLA) annual conferences, and connect with language educators who attend these conferences.

In addition, CALPER will launch an annual webinar series building on the success of Penn State’s *Language Teaching Forum* and *Workshops in Research Methods for Applied Linguists*. This webinar series, provisionally titled *The CALPER Webinars in Innovative Language Teaching*, will host national experts in language pedagogy, especially of LCTLs, to give hands-on workshops on topics connected to language teaching, curriculum design, and assessment. Each year, our webinar series will take place during the spring semester and will include six webinars, each lasting at least two hours. There will be no cost to register, and all webinars will be openly available and easily accessible after the event, including access to materials and resources connected to the webinar.

Additional dissemination activities include CALPER’s Electronic Newsletter,

its PD Documents, Working Papers, Resource Guides and Digests, which alert and inform language educators across the country about CALPER’s events, new products, and opportunities to engage and collaborate. We also disseminate information through our electronic mailing list and social media. These efforts draw on CALPER’s dissemination resources built up and strengthened over the last twenty years.

* + 1. COLLABORATIVE PROJECT WITH THE NHLRC AT UCLA. *Coordinators*: CMT. The NHLRC will

contribute to Project 1 (Language Use in World Language Classrooms) by facilitating classroom

recordings of Japanese and Russian language classes and contributing these to the publicly available corpus and resources to be created for that project. The NHLRC will also contribute to the development of recording and observation protocols, thus strengthening the impact of the project’s conclusions. Additionally, the director and co-director will collaborate with the NHLRC Director for Pedagogy and the NHLRC staff on teacher PD, such as the yearly heritage teacher workshops. Teaching materials developed through CALPER-supported projects and relevant for learning and teaching HLs will be shared through the NHLRC’s repository of teaching materials.

* + 1. Collaborative project with cercll at the university of arizona. *Coordinators*:

CMT. *Competitive Priority*: CALPER will partner with the University of Arizona, an MSI, by providing teacher registration scholarships for the event.

The Center for Education Resources in Culture, Language, and Literacy (CERCLL) at the University of Arizona will organize a biennial series of conferences in 2024 and 2026, titled *Intercultural Learning, Global Citizenship and Peacebuilding* (2024) and *Intercultural Competence in a Rapidly Changing World: Supporting Inclusive and Sustainable Futures* (2026). In line with CERCLL’s virtual conference held in 2022 on a similar topic, these events are intended to enhance teachers’ intercultural effectiveness in the classroom as they prepare students to become interculturally competent global citizens. CALPER will provide six stipends to support teachers to participate in this high-quality professional event. CALPER will support participants from the Pennsylvania and Texas regions who teach at MSIs.

* 1. **Equal Access to Underrepresented Groups.** CALPER involves significant involvement with government-recognized MSIs. First, CALPER will be implemented in partnership with UTSA, an MSI in the South-Central Texas area. In addition, two projects will be led by faculty at UTSA,

Projects 2 (Kisselev) and 5 (Tian & Huang). Project 7 (Bluemel) also involves significant involvement of faculty at an MSI through collaboration with Delaware State University. This project will also enhance aspects of the language curriculum at that university.

In addition, Penn State is committed to providing equal access and equal treatment to all groups, especially those that have been traditionally underrepresented. Penn State’s Center for Language Acquisition adheres to and practices this policy. For example, participants and stakeholders in the Center’s projects and events have included members of groups that have been traditionally underrepresented, such as members of racial and ethnic minority groups, women, and handicapped persons. In addition, McManus has implemented this approach in his research projects, most recently in the activities of CALPER, which include joint activities with MSIs (e.g., California State University, Delaware State University) and a focus on LCTLs. Not only does the proposed project’s collaboration with UTSA continue the Center’s long-term adherence and practice of providing equal access and equal treatment to all groups, especially those that have been traditionally underrepresented, but the creation of freely accessible materials resulting from CALPER’s projects means they can be used by everyone.

Lastly, given the locations of the two primary institutions involved in CALPER’s consortium, Central Pennsylvania and South-Central Texas, we seek to draw language educators from regional MSIs to our events and outreach activities. In particular, we will target MSIs in Pennsylvania (e.g., Cheney State University, Lincoln University), Maryland (e.g., Howard University, Morgan State University, Bowie State University), Ohio (e.g., Central State University), and Texas (e.g., Texas Tech University, Texas State University) to apprise teachers of the materials, activities and events included in our proposal, especially our workshops.

Although all institutions mentioned offer programs in more commonly taught languages at some

level (e.g., Spanish), some offer courses in LCTLs that are within CALPER’s scope—Morgan State University (Arabic, Russian), Lincoln University (Arabic, Chinese), Central State University (Chinese), Texas State University (Arabic, Japanese), and Texas Tech University (Arabic, Korean, Russian).

# QUALITY OF KEY PERSONNEL

We present short descriptions of the background and qualifications of the director, co-director, associate director, and individual project coordinators. Brief CVs are included in Appendix 1.

* 1. *Director.* Kevin McManus is the Gilbert R. Watz Early Career Professor in Language and Linguistics, Associate Professor of Applied Linguistics, and Director of the Center for Language Acquisition at Penn State. He has (co-)authored six books and twenty-six journal articles and book chapters in applied linguistics, second language learning and teaching, and research methodology. He is recipient of the 2020 *ACTFL-NFMLTA/MLJ Paul Pimsleur Award for Research in Foreign Language Education* for his work on instructional effectiveness and L2 learning. He has co-authored four successful Title VI IRS grant proposals since 2016 with projects involving UBLI in Korean and Russian, DLI programs, and the careers of study abroad alumni. In terms of teaching and advising, McManus has taught courses in French language and linguistics, applied linguistics, usage-based learning theory and language teaching, second language acquisition, and is (co-)adviser of 12 doctoral candidates. He has been co-director of CALPER since 2018, leading projects in multiple LCTLs, including Chinese, Korean, and Russian. McManus will dedicate 15% time (or 1.3 months summer) to CALPER.
  2. *Co-director.* Olesya Kisselev is Assistant Professor of Applied Linguistics at UTSA. Her Ph.D., awarded in 2018 and titled *Word order and information structure in the writing of heritage and second language learners of Russian,* won the prestigious NFMLTA/NCOLCTL

Dissertation Support Grant. Kisselev’s research expertise is in the areas of L2 and HL acquisition, L2/HL pedagogy, and learner corpus research. She has published and presented widely on these topics at national and international venues. She is (co-)author of 21 journal articles and book chapters in L2/HL development, and L2/HL learning and teaching, and has given numerous talks and webinars on these topics. She recently co-edited a two-volume special issue of the *Heritage Language Journal* on complexity in HLs. At UTSA, Kisselev teaches undergraduate and graduate level courses on language and linguistics, L2 and HL acquisition, and L2/HL pedagogy. In addition, as a recipient of the yearly STARTALK grant since 2016, Kisselev has trained dozens of teachers of Russian as a L2/HL language. Kisselev has been involved in the field of HL for many years, both as a researcher and as a language practitioner; she has served as faculty at the Heritage Language Research Institute since 2008 and has contributed to the Institute’s agenda. Prior to engaging in her doctoral work, Kisselev taught Russian language courses and developed curricula and instructional materials for the innovative Russian Flagship program at Portland State University. She continues to contribute to the field of teaching Russian; her most recent work includes the textbook *Родная Речь: An Introductory Course for Heritage Learners of Russian,* which won the American Association of Teachers of Slavic and Eastern European Languages (AATSEEL) book award for Contribution to Pedagogy (2020) and a learning platform *Digital Russian: Russian for Heritage Learners.* Kisselev will dedicate 15% time to CALPER.

* 1. *Associate director.* Jialing Wang, research technologist in the Center for Language Acquisition and CALPER at Penn State. She is a D.Ed. candidate in higher education at Penn State with a specialization in research administration and internationalization of higher education. She holds an M.Ed. in TESOL and world language acquisition from the University of Georgia and has

taught courses in Mandarin and ESL/EFL in China and the US at different levels of proficiency. With experience in international business, she has supported CALPER’s administration, finance, and event planning since 2016.

* 1. *Project Coordinators (presented in alphabetical order)*

BRODY BLUEMEL is Department Chair and Associate Professor in the Department of Languages and Literatures at Delaware State University. He has expertise in Applied Linguistics, Chinese, and German. His research focuses on bilingual education, DLI, and educational technology. He has conducted research on the use of corpora in language pedagogy, and recently led a Title VI IRS project focused on dual-enrollment in Spanish and Chinese in the elementary and middle schools of the state of Delaware. Bluemel will dedicate 10% time to CALPER.

BECKY H. HUANG is an Associate Professor of TESOL/Applied Linguistics and Director of the *Language Learning and Assessment Laboratory* at UTSA. She holds a Ph.D. in Educational Psychology from UCLA. Her research focuses on bilingual/dual language learners’ language/literacy development and assessment. She has published widely in applied linguistics and education journals, such as *Teachers College Record*, *International Journal of Bilingualism*, *Reading Research Quarterly*, *System*, *Language Testing*, and *Language Assessment Quarterly*. Huang will dedicate 5% time to CALPER.

AMANDA HUENSCH is Assistant Professor in the Department of Linguistics at the University of Pittsburgh. She received her PhD from the University of Illinois at Urbana-Champaign and currently serves as Associate Editor for *Applied Psycholinguistics* and Reviews Editor for the *Journal of Second Language Pronunciation*. Her research examines L2 speech development in and outside of the classroom, including the acquisition of L2 phonology, and the pronunciation pedagogy practices of foreign language instructors. Her expertise in applied phonetics, L2

learning, and the development of longitudinal learner corpora will make a strong contribution to

her CALPER project. Huensch will dedicate 10% time to CALPER.

AKIKO IMAMURA is an Assistant Professor and the Japanese language program coordinator at Michigan State University. She teaches Japanese as a foreign language and an introductory course to Japanese sociolinguistics and applied linguistics. Her research centers on language use and social interaction as L1 and L2. Her most recent paper on Japanese compliments has been accepted for publication in *Discourse Studies*. Her broader interests include Japanese language pedagogy and language program direction. Imamura will dedicate 5% time to CALPER. STEPHEN DANIEL LOONEY is Teaching Professor of Applied Linguistics and Director of the International Teaching Assistant Program at Penn State. He obtained his PhD in Linguistics from the University of Georgia and has expertise in conversation analysis and L2 teaching. His interests include language use, classroom interaction, L2 assessment, and teacher training. His research has been published in esteemed outlets such as *Discourse Studies*, *TESOL Quarterly*, and *Journal of Pragmatics*. Looney will dedicate 10% time (or 0.8 summer month) to CALPER. INNHWA PARK is an Associate Professor of TESOL in the Department of Languages and Cultures at West Chester University, in Pennsylvania. She obtained her PhD in Applied Linguistics from UCLA and has expertise in conversation analysis and language education. Her research interests include L2 use, educational discourse, online communication, and meeting interaction. She has recently published her research in *Applied Linguistics Review*, *Discourse Studies*, and *Language Learning*. Park will dedicate 5% time to CALPER.

JAYOUNG SONG is an Assistant Professor of Korean in the department of Asian Studies at Penn State. Her research focuses on Korean applied linguistics, computer-assisted language learning, intercultural communication, and L2 reading, all of which she incorporates into her teaching. She has published articles in peer-reviewed journals such as *Language Learning and*

*Technology, Recall, The Korean Language in America,* and *Linguistic Research.* Song will dedicate 10% time (or 0.5 summer month) to CALPER.

ZHONGFENG TIAN is an Assistant Professor of TESOL/Applied Linguistics at UTSA. He holds a PhD in Curriculum and Instruction from Boston College. Theoretically grounded in translanguaging, his research centers on working with classroom teachers to provide bi/multilingual students with equitable and inclusive learning environments in ESL and Chinese- English DLI contexts. He has published articles in *TESOL Quarterly*, *System*, *Applied Linguistics Review*, and *Language and Education*. Tian will dedicate 10% time to CALPER.

* 1. **Non-discriminatory Employment Practices***.* As major public research universities of the Commonwealth of Pennsylvania and the State of Texas, Penn State University and UTSA provide equal opportunity in all terms and conditions of employment, for all persons. The universities are committed that all persons shall have equal access to employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by university policy, contract, or state or federal authorities, and that the universities do not discriminate against any person because of age as defined by law, ancestry, color, disability, or handicap, national origin, race, religious creed, sex, sexual orientation, or veteran status. This policy of equal opportunity applies to, and must be an integral part of, every aspect of personnel policy and practice in the employment, development, advancement, and treatment of employees and applicants at the respective universities. The academic departments from which the CMT for CALPER is drawn are primarily comprised of non-Caucasian male faculty. Of 15 full-time positions in Penn State’s Department of Applied Linguistics, 11 are women and minority faculty, and four are Caucasian males. Of the 16 tenure-line positions in UTSA’s Department of Bicultural-Bilingual Studies, 15 are women and minority faculty, and one is a Caucasian male.
  2. **Evidence of Relevant Past Experience of Key Personnel.** In addition to the commentary provided above summarizing the background qualifications of key personnel, the appendix includes short CVs that provide additional evidence of the relevant experience of the key personnel, all of whom have significant graduate level preparation and work experience in applied linguistics, language teaching, and materials development. In addition, the director responsible for designing, implementing and overseeing the projects in the current proposal has a record of co-authoring and managing four successful Title VI grant proposals, including one LRC, and is currently director of the Center for Language Acquisition at Penn State.

# BUDGET AND COST EFFECTIVENESS

Penn State provides substantial support and resources for CALPER’s daily operation. The full- time salary of the associate director and staff are paid by the College of Liberal Arts. Spaces are provided at no cost to meet CALPER’s needs, including offices for director, associate director, staff, and graduate assistants, as well as meeting rooms, classrooms, and an auditorium for invited talks and PD activities. Essential equipment and technological support including the development of CALPER’s website is provided by the College. The CALPER budget will maximize efficiency using existing resources and institutional support from Penn State. Because this project is primarily labor intensive, the majority of costs are directed at personnel remuneration. Some modest costs for expenses connected with dissemination at national and regional language education events and for equipment to support the conduct of innovative and effective projects have been included. Any unexpected costs can be covered by the Center for Language Acquisition. We believe that the amount of funding to be allocated to the project is appropriate given each individual’s time contribution.

# EVALUATION PLAN

Robust internal and external evaluations are integral to meeting the goals and objectives of CALPER. Our plan for evaluation takes account of the four UBLI principles that frame our proposed projects as they relate to the teaching and learning of LCTLs. In addition, the evaluation plan is multidimensional because it incorporates formative and summative assessments to measure progress and accomplishment, quantitatively and qualitatively.

The CMT will collect semi-annual and annual reports produced by the coordinators of each project. These reports will be used to determine progress made toward meeting each project’s objectives. The semi-annual reports will be evaluated against the objectives and where necessary the coordinators will be asked to modify and/or accelerate their work to ensure that project objectives are met. The yearly reports will be distributed to the EP. In addition, for each project that includes piloting the components of the project as they are developed, feedback from teachers and students will be collected using online data collection tools (e.g., surveys, ratings), resulting in quantitative data for the project. These data will be shared with the EP for analysis and reporting. In addition, CALPER will develop and administer quantitative evaluation surveys for all its dissemination events and will record activity on its websites and other interactive platforms to gauge interest and use of its products.

All information collected at year end will be distributed to the EP for evaluation against each project’s objectives and the broader objectives of CALPER. The EP will then produce a written report of their evaluation with recommendations for modifying and/or accelerating the work of each project, if required. The EP will present and discuss its report with the CMT.

Throughout CALPER’s four-year cycle, the CMT will work closely with the EP for independent evaluation of the LRC’s activities. The EP will meet with the CMT twice virtually (Years 2 and 3) and twice in person (Years 1 and 4) during the grant cycle. The initial meeting

will be held in October 2022 to review the plan of operation, indices of performance, and data collection methods. The CMT will then meet with the EP in May of each subsequent year to review outcome-based data on completed activities and advise on further improvement. The EP will comprehensively measure the progress of each project and provide written reports and recommendations for future work.

At the end of the grant cycle, the EP will evaluate the grant holistically in June 2026. The EP will be asked to write a summative evaluation focusing on the quality of projects, accessibility, and impacts. In addition to the summative evaluation based on the quantitative data received for each project, the EP will also quantitatively and qualitatively report and evaluate each project’s activities and products in terms of their quality, usefulness, and relevance for improving the Nation’s capacity for teaching and learning foreign languages. For example, the EP will be asked to respond to the following questions: To what extent do the instructional materials and practices meet CALPER’s performance goals? To what extent have PD activities prepared teachers in four effective language teaching practices informed by UBLI principles? To what extent have the dissemination activities increased the capacity of US foreign language educators to maximize the development of advanced language proficiency? What changes are needed to current activities and strategies in order to better meet CALPER’s objectives?

*Evaluation panel.* Two experts in world language education and quantitative research make up our evaluation panel (see appendices 1 and 3 for CVs and letters of support):

Dr. Victoria Hasko is Associate Professor of TESOL & World Language Education, Director of the Russian Flagship Program and the STARTALK Russian Language, Culture and Communities in the Baltics Program at the University of Georgia. Hasko specializes in L2 acquisition, with a focus on instructed language learning, learner corpus research, and computer

assisted language learning. She has over 30 published papers, book chapters, and (co)edited volumes. Her research expertise centers on language learning of LTCLs (e.g., Russian, Portuguese). As the director of the Russian Flagship program and the director of STARTALK Russian for Global Professionals (federally-funded program for teaching critical languages), Hasko has expertise on administration and implementation of federally-supported programs.

Dr. Luke Plonsky is an Associate Professor of Applied Linguistics at Northern Arizona University, where he teaches courses in L2 acquisition and research methods. His work in these and other areas appears in over 100 articles, book chapters, and books. The bulk of his efforts include an agenda to improve and advance the methodological capability of applied linguistics research. Plonsky is Senior Associate Editor of *Studies in Second Language Acquisition*, Managing Editor of *Foreign Language Annals*, and he serves on the editorial boards of several other journals, including *Language Teaching* and *Research Methods in Applied Linguistics*.

# ADEQUACY OF RESOURCES

As a long-standing LRC with twenty active years of operation, CALPER has already established a solid infrastructure, including personnel, supplies and equipment, and technological support for its activities.

* 1. *Facilities:* The main office of CALPER at Penn State is located in a designated suite of five offices which house the director and associate director. The Center for Language Acquisition, in which CALPER is embedded, and the affiliated Department of Applied Linguistics provide additional resources that CALPER draws on. These include staff members that work with the associate director on budget matters and event organization. Four permanently funded graduate assistant (GA) lines with appropriate language abilities support CALPER’s projects as required. The GAs, selected from the doctoral program in applied linguistics, are either natives or highly

proficient speakers of the languages included in this proposal with strong preparation in research methods, data collection and analysis, and language teaching. CALPER also collaborates closely with other entities on campus, including Penn State’s Title VI National Resource Center, and other university centers and language departments.

CALPER’s UTSA site will be located in the Department of Bicultural-Bilingual Studies and the Academy for Teacher Excellence (ATE) that include a robust support staff with Emily Young (Center Coordinator for ATE) and Effie Mata (Education Specialist at ATE), who will assist with project implementation, administration, outreach activities, and reporting. GAs, selected from the doctoral students in Culture, Language and Literacy, have a range of skills and knowledge in applied linguistics and language teacher education and represent highly-proficient speakers of world languages (including Brazilian Portuguese, Arabic, Mandarin Chinese, etc.).

In addition to the infrastructure support provided by the Department and ATE, two of the project coordinators, Huang and Tian (see Key Personnel 2.d.) have technological expertise that will also support the various projects. Finally, the College of the Liberal Arts at Penn State has also recently established a Media Commons Center that provides support to the digital needs of centers and other units in the College.

* 1. *Equipment and Supplies:* CALPER has its own designated laptops/computers, projectors, and video and audio recording equipment. The Department of Bicultural-Bilingual Studies at UTSA also has a robust inventory of equipment that will be available for CALPER designated projects.

# NEED AND POTENTIAL IMPACT

Research to date has repeatedly shown that teaching methods recommended for use in world language classrooms do not reliably lead to improvement (De Graaff & Housen, 2009; Kang et al., 2019), especially methods that prioritize the *amount* of input. For example, ACTFL

forefronts 90% plus target language use and comprehensible input in its ‘core practices’ to effectively support L2 learning (see ACTFL 2020). However, even though theories of language learning acknowledge that input is important (see Gass, 2017), it is also known that FL learning outcomes cannot be explained by input alone (Nassaji & Fotos, 2011; VanPatten, 2017). In addition, these input-focused instructional practices are not designed to address specific language learning difficulties and are not based on empirical research evidence, but instead are based on general education theory or learning hypotheses (Krashen, 1982). Instruction that prioritizes the amount of input leads to mixed results because (i) it only partially addresses the nature of the learning problem, (ii) it does not address specific language learning difficulties, and (iii) it is not based on empirical research evidence (see McManus, 2022a; Tyler & Ortega, 2018). Indeed, as argued by Jackson and Malone (2009, p. 18), “the single most important factor in whether language is learned or not is the competence and skill of the teacher”. Under this view, “teacher competence crucially includes both proficiency in the language and culture and professional knowledge and ability as a language teacher” (ibid.). Certainly no one would dispute the importance of the exposure to the target language and the linguistic abilities of teachers for effective pedagogical practice, but as suggested by Jackson and Malone, this capacity alone is not sufficient for L2 learning outcomes.

A multi-step approach is needed to address this situation. First, instruction needs to target specific language learning difficulties (VanPatten, 2017). To do this, educator-researcher collaborations are needed so that instructional methods focus on specific aspects of the L2 that are difficult to learn, as evidenced by empirical research (Keck & Kim, 2014). Second, instructional materials need to be trailed with classroom learners and used in classrooms in order to understand how effectively they support learning (Tyler & Ortega, 2018).

To address this critical need in the field, CALPER proposes a series of projects that develop evidence-based instructional materials and PD units grounded in principles of UBLI. One reason for adopting an UBLI approach to improving the Nation’s capacity for teaching and learning foreign languages is that a robust and well-studied body of research comes from usage- based L2 research and language education research, especially studies investigating the ways in which a speaker’s prior language knowledge and experience can influence the rates and routes of FL learning (see McManus, 2022a). This body of evidence is particularly relevant because all speakers begin L2 learning with a fine-tuned, established system of language knowledge, usually their L1, that is known to bias how they interact, attend to language, and use language in specific ways, thus influencing L2 learning negatively and positively (Ellis, 2006; MacWhinney, 2008; McManus, 2022a). As a small but growing line of instructional research has shown, learning can be improved in a variety of skills by designing instruction that draws on this evidence base to address specific learning difficulties (see McManus 2019, 2020).

Through an evidence-based approach to language instruction grounded in empirical second language acquisition (SLA) research, designed to address specific language learning difficulties, and supported by educator-researcher collaboration, this project addresses a critical need in the field, vital for advancing knowledge and understanding about evidence-based methods for strengthening and improving LCTL teaching in the US.

# LIKELIHOOD OF ACHIEVING RESULTS

The CMT are experienced managers of various projects and units within academia. McManus has served as co-director of CALPER since 2018. He has also been involved with directing the Center for Language Acquisition at Penn State since 2016 (initially as associate director and as director since 2019). As director, McManus is responsible for the center’s day-to-day running,

including managing staff, annual budget, research and education projects in applied linguistics, as well as all administrative and financial reporting and planning. In this capacity, he has also launched several initiatives designed to support and invigorate research and high-quality language pedagogy at Penn State and beyond. For example, he is organizer of the successful *Penn State Workshops in Research Methods for Applied Linguists*, an annual event of hands-on workshops for researchers in the use of cutting-edge research methods. These events are all delivered via videoconference, to international audiences, and participation is free. As an index of their reach, in 2021 our four workshops included 1,340 confirmed attendants. In addition to these workshops, McManus is also organizer of Penn State’s *Language Teaching Forum* as well as the *Penn State–NECTFL Fellowship Program in Language Education*, both are critically- needed, well-attended, and highly-successful initiatives that invigorate and support high-quality language teaching at Penn State, especially for LCTLs. Briefly, the *Forum* is an annual event which invites an internationally recognized expert in language pedagogy to discuss innovative approaches to teaching, curriculum design, and language assessment (e.g., in 2021, Julie Sykes from the Center for Applied Second Language Studies (CASLS); in 2020, Margaret Malone from the Assessment and Evaluation Language Resource Center (AELRC), Georgetown University). For our Fellowship program, we support a Penn State language educator each year to (i) develop a foreign language project in the classroom that contributes to the profession and advances quality language instruction and (ii) present that project and its findings at NECTFL’s annual conference. In addition, McManus has also been (co-)PI on four Title VI IRS grants.

Taken together, these experiences highlight that McManus is an accomplished leader capable of overseeing the complex operations of CALPER.

Kisselev has experience in running grant-supported activities, both in language and pedagogy research and teacher preparation. As Lead Instructor on the federally-supported *STARTALK: Proficiency-based pedagogy for teachers of Russian* program, Kisselev is charged with conceptualizing the program, creating the grant proposal, developing, and administering the teacher development program. Since 2016, together with a team of collaborators, she has been the recipient of six successful STARTALK grants and has helped trained dozens of teachers.

Kisselev has also served as a stream organizer for AATSEEL’s annual convention and has put together five streams on the acquisition and pedagogy of Slavic languages. Organization of the stream includes conceptualization of the stream, inviting speakers, organizing panels, and chairing talks. Kisselev has also been involved in organizing the Heritage Language Institutes, the hallmark yearly event of the NHLRC. As a (co-)PI on a number of research projects, Kisselev has developed experience working with collaborators, graduate assistants and administrators.

Wang has supported CALPER as an administrative assistant since 2016 and has worked closely with the previous associate director (Gabriela Appel) on the day-to-day operation of the unit. She has thus developed experience working with the project coordinators and has been responsible for organizing and formatting the appearance of the relevant deliverables produced by the projects. She has also been responsible for assisting with CALPER’s workshops.

In keeping with the notion that the design, creation, development, and refinement of evidence-based instructional materials and PD opportunities require extensive and intensive knowledge of the relevant subject matter, all of CALPER’s project coordinators have advanced graduate degrees in applied linguistics and language teaching and have high-quality knowledge of the linguistic concepts of the relevant language(s). They have carried out and published

research in the relevant language and have developed teaching materials or have implemented instructional practices grounded in this research (see Appendix 1 for CVs).

Projects 1-4 involving Arabic, Japanese, Korean, and Russian rely on authentic examples of language as collected in spoken and written corpora. All three project directors have strong backgrounds in generating and working with large language databases, including language corpora. They have used these resources to produce viable pedagogical materials and have provided training on how to use these resources for learning and teaching. Kisselev, for instance, has considerable expertise in collecting and analyzing learner corpora. Her first corpus project, the *Russian Learner Corpus of Academic Writing* (RULEC), is a longitudinal corpus of advanced level writing produced by mainstream L2 students and HL learners of Russian. Since RULEC effectively became the first freely-available and systematically-compiled corpus of learner Russian, the corpus has been used in research by a number of colleagues in the US and internationally (e.g., Pierce, 2018; Polinsky et al, 2016; Rakhilina et al., 2016; Rozovskaya & Roth, 2019). In 2019, with a grant from the Kathryn Wasserman Davies School of Russian (Middlebury College, VT), Kisselev began developing the Middlebury Corpus of Learner Russian, a longitudinal learner corpus that includes writing and speech samples of L2 learners of Russian across various proficiency levels. This corpus boasts a more sophisticated tagging schema, where “sophistication” implies multiple levels of transcription, standardization, tagging and annotation—all with the purpose of producing more fine-grained and comprehensive analysis of the language data with the help of computational tools. The corpus is fully available to researchers and teachers for research and materials development.

Similarly, McManus and Bluemel have created large corpora of DLI classrooms (McManus & Bluemel, 2022), which have been used to design and create PD units for dual-

language teachers in the State of Delaware. McManus is also co-creator of the extensive LANGSNAP corpus, a longitudinal corpus of spoken and written French and Spanish that is a freely available resource for researchers, teachers, and learners, and that has been used to support a number of PD initiatives to better prepare students to study abroad (see Mitchell et al., 2017). Using corpora for pronunciation teaching and research, Huensch regularly gives workshops to language teachers and scholars on some of the tools best suited for exploiting oral learner corpora for understanding areas of learning difficulty, which can then be used to develop instructional materials and PD units (see Huensch & Staples, 2022).

Looney is an experienced creator and developer of corpus-based resources for PD and teacher training. For example, he has made significant contributions to Penn State’s *Corpus of English for Academic and Professional Purposes* (CEAPP), which he uses in his role as Director of the International Teaching Assistants program as a source of training. Of particular importance to Looney’s project is the experience he brings from working on CEAPP over the years. Briefly, CEAPP is an online corpus of videos and their transcripts of naturally occurring interactions collected from classroom settings. These data have been used to create tutorials for teaching a variety of linguistic features and structures. Given that Looney’s project involves similar data collection procedures, but of naturally occurring conversations in Japanese, this experience will be critical in successfully bringing the project to fruition.

Song is an accomplished creator and developer of technology for use in the classroom, which is a line of expertise she developed during her doctoral studies at the University of Texas at Austin. Since then, she has received numerous educational and technology grants to support this work (e.g., Academy of Korean Studies). For example, in a recent project, Song examined how 360-degree virtual reality videos enhanced intercultural competence for learning L2 Korean

(for a detailed description, see Song 2019). Briefly, Song filmed 360-degree VR videos of naturally occurring scenes in South Korea, with the aims to (i) capture authentic Korean conversation in everyday contexts, (ii) provide a context for role-playing everyday tasks during classroom learning activities, and (iii) illustrate cultural elements in meaningful way. As this experience indicates, Song is an accomplished designer and user of technology in the classroom and has considerable experience communicating her expertise to teachers.

# DESCRIPTION OF FINAL FORM OF RESULTS

For each project we describe the final form of the products and procedures with as much specificity as feasible at this stage.

* 1. *Language use in world languages classrooms.* The project will generate (i) a freely available corpus of language use in world language classrooms and (ii) two specific sets of materials as well as PD workshops. Teachers’ language use in world language classrooms (Arabic, Korean, and Russian) will be transcribed and made freely available to the language education community to inform research and policy on language use in world language classrooms. In terms of materials, the first set will comprise a series of written reports with linked audio describing the proportions, functions, and frequencies of L2, L1, and other language use in Arabic, Korean, and Russian elementary and intermediate level world language classrooms. These reports will lead to a series of evidence-based guidelines for teachers’ strategic language use to maximize L2 learning (thus complementing ACTFL’s “Going for 90% plus” recommendation). The second set of materials will be a series of PD workshops designed to help teachers efficiently and effectively integrate these guidelines into their own instructional practices. The information provided in the workshops will be available on CALPER’s webpage.
  2. *Literacy instruction to support advanced language proficiency in HL Russian.* The principal product from this project will be the creation of an instructional approach to literacy development for HL learners of Russian. This approach will be grounded in UBLI principles in order to develop awareness of Russian phonology, morphology, and morphological structure. Part of this process will involve the development of a new taxonomy of orthographic errors, derived from the extensive corpus-based analyses that underpin the instructional approach. This taxonomy will then be used to make evidence-based recommendations for instruction that target specific types of learning difficulties. The instructional approach will be developed into sets of PD modules that will be (i) usable by learners and teachers, (ii) thematically presented with specific target features, and (iii) made publicly available.
  3. *Instructional materials for pragmatic and interactional competence in Japanese.* Two products will be the primary outcomes of this project. First, a corpus of video-recorded and transcribed spoken interaction will be constructed by collecting authentic speech samples from speakers of Japanese. These speech samples will be collected from conversations and interviews to understand a variety of social activities encountered in daily life. After data collection and analyses, this corpus will be used to compile instructional units for teaching pragmatic routines and interactional competence (e.g., making requests, telling jokes). In addition, both the corpus and the instructional materials will be made freely available to learners and teachers. In particular, the corpus resource, which will include a rich repository of language data for use in classrooms and independently by learners and teachers, will be housed on a user-friendly interface that additionally houses CALPER’s other corpus materials (e.g., from projects 1, 2, 4).
  4. *Advanced pronunciation instruction in L2 Arabic.* This project will result in a survey and synthesis of the needs, attitudes, and current practices of LCTL instructors regarding

pronunciation teaching and learning. This product will be valuable since very little is currently understood about pronunciation and its teaching in LCTL classrooms. In addition, an oral learner corpus will be constructed to better understand potential patterns of (non)target-like usage of different pronunciation features in Arabic. The corpus will be built from L2 speakers of Arabic performing a variety of communicative tasks. This corpus will be used to better understand the types of language produced by learners of different proficiencies as well as to isolate pronunciation difficulties. Using this evidence base, a series of workshops and PD units will be designed to help instructors insert pronunciation activities into their existing lessons. All the materials from this project (corpus, workshop materials, PD units) will be made publicly available to learners and teachers with interests in pronunciation.

* 1. *Teacher training in Chinese immersion classrooms.* First, a needs analysis will be carried out using an online survey and conducting one-on-one interviews with Chinese teachers. Based on the results of this first phase, a series of specialized PD workshops will be designed that address Chinese immersion teachers’ needs from different dimensions, such as pedagogical techniques to promote advanced Chinese language and literacy proficiency, curriculum design and material development, and assessment. To increase accessibility, all PD opportunities will be delivered virtually. The effectiveness of the PD workshops will be evaluated through collecting quantitative and qualitative data from teacher participants. The data sources for evaluation will draw from pre- and post-test teacher surveys, semi-structured teacher interviews, class observations and teachers’ artifacts.
  2. *Augmented reality for Korean language and culture teaching.* This project will create a mystery-solving game-based learning app, titled *The Secret Letter from Gyeongbok Palace*. This app will be used in advanced Korean classes in order to provide students with opportunities to

learn Korean language and culture in an engaging and enriching way. The learning app will present Korean history and cultural artifacts with narrative-driven AR educational games.

This project will make practical and theoretical contributions to the existing Korean programs in distinct ways. First, the curriculum will benefit a significant number of students and teachers who are enrolled in advanced Korean programs nationally and globally. Once the mobile-based AR app is developed, it will be publicly shared with instructional guidelines so that Korean language learners and teachers can use it for their teaching and learning. Theoretically, this study will inform L2 researchers and curriculum developers of the possibilities of using AR in terms of developing students’ reading and cultural knowledge. The study will provide empirical evidence on whether and to what extent innovative technology can be used as a platform for language development.

* 1. *Language instruction using immersive technology.* This project will provide instructors with the resources, guidance, and skills necessary to adapt immersive technology for use in world language classrooms. To achieve this goal, the project will create a digital training guidebook on how to adapt immersive technology for language teaching and create instructional resources and materials. A final component of this project will be the creation of modules of fully developed lessons for Chinese, Bambara, and Portuguese on using immersive technology.
  2. *Dissemination of CALPER’s research tools and instructional materials.* At least two webinars will be delivered for projects 1-7, designed for both general audiences and more language- focused or skill-focused audiences. Each webinar will last at least two hours and will be made freely available to the language teaching community after the event. These will be housed on CALPER’s website, with postings on social media (Facebook, Twitter).

Project coordinators will submit presentations to professional conferences (such as ACTFL, NECTFL, the various AATs and their regional affiliates). We will also exhibit our materials and products at national, regional, and state annual conferences, and connect with language educators who attend these conferences.

CALPER will launch an annual webinar series, provisionally titled *The CALPER Webinars in Innovative Language Teaching*. We will host national experts in language pedagogy, especially of LCTLs, to give hands-on workshops on topics connected to language teaching, curriculum design, and assessment.

Lastly, all resources created as part of CALPER’s projects will be made openly available and easily accessible to language educators and learners.

* 1. *Collaborative project with NHLRC (UCLA).* The NHLRC will contribute to final products to be realized as part of Project 1 (Language Use in World Languages Classrooms) through classroom recordings of Japanese and Russian language classes and contributing these to the publicly available corpus and resources to be created for that project. Additionally, the director and co-director will collaborate with the NHLRC Director for Pedagogy and the NHLRC staff on teacher PD opportunities, including the yearly heritage teacher workshops. Teaching materials developed through CALPER-supported projects and relevant for learning and teaching heritage languages will also be shared through the NHLRC’s repository of teaching materials.
  2. *Collaborative project with CERCLL (AZ).* CALPER’s contribution to the bi-annual conference organized by CERCLL will provide monetary support for six teachers in total to attend the conference in year 2 and 4.

# COMPETITIVE PREFERENCE PRIORITY: PROMOTING EQUITY IN STUDENT ACCESS TO EDUCATIONAL RESOURCES AND OPPORTUNITIES

Based at Penn State, CALPER will be implemented in partnership with UTSA, an MSI. One additional project includes significant collaboration with Delaware State University, an MSI based in Delaware. CALPER will also partner with other MSIs in smaller roles, including the University of Arizona (via CERCLL) and Northern Arizona University (via Plonsky).

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