

Digital free-to-use technologies for language maintenance in California's Central Coast Nuu Savi (Mixtec) diaspora

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ABSTRACT

The latest developments in digital technology over the last two decades have dramatically changed the way we communicate, interact, and disseminate information. For Indigenous and endangered languages, these developments are opening new spaces to support language use and language learning. In addition, digital technology and the Internet offer diaspora communities the possibility to strengthen or build new connections with their home communities. In this paper we present the collaborative model behind the Let's Learn Mixteco project and the development and website integration of digital language-learning resources for Tù'un na Nuu Sá Mátxîi Ntxè'è (San Martín Durazos Mixtec, Otomanguean). The project is built on a partnership between linguists, Mixtec language workers in California, and instructional technology designers. Methodologically, the pedagogical materials are developed within the framework of gamification and game-enhanced learning. We use existing free and user-friendly online platforms for developing and maintaining online pedagogical materials for language learning. This work presents a model for the application of digital tools for language advocacy and learning that are culturally-sustaining, accessible, economical, and which require relatively little technical expertise to create.

RESUMEN

Los últimos avances de la tecnología digital en las dos últimas décadas han cambiado radicalmente la forma en que nos comunicamos, interactuamos y difundimos información. En el caso de las lenguas indígenas y en peligro de extinción, estos avances están abriendo nuevos espacios para apoyar el uso y el aprendizaje de las lenguas. Además, la tecnología digital y el Internet ofrecen a comunidades en la diáspora la posibilidad de reforzar o establecer nuevas conexiones con sus comunidades de origen. En este artículo presentamos el modelo de colaboración sobre el cual se ha elaborado el proyecto *Aprendamos Mixteco* y se han integrado recursos digitales de aprendizaje de lenguas para *Tù'un na Nuu Sá Mátxiì Ntxè'è* (mixteco de San Martín Durazos, otomangue) en un sitio web. El proyecto se basa en una colaboración entre lingüistas, trabajadores de la lengua mixteca en California y diseñadores de tecnología educativa. Metodológicamente, los materiales pedagógicos se desarrollan en el marco de la gamificación y el aprendizaje facilitado por el juego. Utilizamos plataformas en línea gratuitas y fáciles de usar para desarrollar y mantener materiales pedagógicos en línea para el aprendizaje de idiomas. Este trabajo presenta un modelo de aplicación de herramientas digitales para la promoción y el aprendizaje de idiomas que son culturalmente sostenibles, accesibles, económicas y cuya creación requiere relativamente pocos conocimientos técnicos.

1. INTRODUCTION

Initiatives in language maintenance and revitalization have focused primarily on Indigenous communities within their ancestral lands (e.g., Florey, 2018; Hinton et al., 2018; McCarty 2018), often with sizeable populations and/or institutional support, while the linguistic needs of Indigenous diaspora communities have traditionally received much less attention. Only recently have there been efforts to understand and address the unique linguistic challenges and inequities faced by peoples living outside their traditional territories due to international migration (Kaufman & Perlin, 2018; Moreno Villamar, 2022; Pérez Báez, 2009, 2012, 2013, 2014) and urbanization (Ávila Molina & Ospina Bozzi, 2022; García-Weyandt & López de la Rosa, 2022; Grenoble, 2022; Söylemez, 2004).

In the United States, Indigenous peoples are a large yet overlooked part of migration from Latin America. Escala Rabadán and Rivera-Salgado (2018) estimate that around 350,000 Indigenous migrants from the Mexican state of Oaxaca alone have settled in California, with large numbers of Zapotec peoples residing in the Los Angeles area and large concentrations of Nuu Savi (Mixtec), Triqui, P'urhépecha and other groups from southern Mexico making up as much as a third of California's essential agricultural workforce (Escala Rabadán & Rivera-Salgado, 2018:39). Indigenous migrant farmworker populations are widespread in California but concentrated in the Central Valley, northern

San Diego County, and the Central Coast (Maxwell et al., 2015; Mines et al., 2010). Large numbers have rooted near Santa Maria (Santa Barbara County) and Oxnard (Ventura County) (Fox & Rivera-Salgado, 2004; Kresge, 2007; Runsten & Kearney, 1994), where community organization has paved the way for collaborations aimed at advancing linguistic justice.

In the remainder of this article, we present the collaborative model behind the Let's Learn Mixteco project ([link](#)), whose goal is to support language maintenance in the Nuu Savi diaspora community in California's Central Coast through free-to-use digital instructional resources. The project offers one framework to address the accelerated language shift in Indigenous diaspora communities by centering technology and pedagogy in establishing a low-cost research model among community language workers, linguists, and digital instructional designers. Such a model can be used to support language learning and language maintenance and raise cultural awareness among local and broader audiences. We outline in detail our motivations, our vision, the technologies we use, and the step-by-step process through which our work can be reproduced, adapted, or leveraged in other contexts and thus inspire similar projects focused on language work. The project context is described in more detail in Section 2. Section 3 presents the members involved in it and outlines our collaborative model. In Section 4 we present the project's methodologies and technologies that have been integral to the process. Section 5 presents the workflow for generating materials and gamified activities. In Section 6 we reflect on our experience creating this framework and some challenges we have faced, and finally, we draw some conclusions in Section 7.

2. COMMUNITY CONTEXTS AND DIGITAL LANGUAGE WORK

"Mixtec" (Tu'un Savi or Tu'un Nda'vi) is a term used to refer to the languages of the Nuu Savi people. In other words, Mixtec refers not to a single language but to a large and diverse group of languages and varieties (Jiménez Moreno, 1962), many of which are not mutually intelligible (Egland, 1982), and which are traditionally spoken in at least 189 municipalities in Oaxaca, Guerrero, and Puebla states in southern Mexico (Smith Stark, 1995). The Mixtec languages are most closely related to the Cuicatec and Triqui languages (Longacre, 1957), together comprising the Mixtecan language group, which is one of several major subgroups of the Otomanguean linguistic stock (E. Campbell, 2017a; L. Campbell, 1997; Rensch, 1976).

Knowledge of Mixtec, Spanish and English varies significantly within diaspora Mixtec communities and across generations, and it is tightly intertwined with the obstacles that people face both in Mexico and in the U.S. These include linguistic discrimination and lack of literacy and education opportunities in their home languages, as well as lack of equal access to education (Ruiz & Barajas, 2012), employment (Mines et al., 2010), and healthcare (Gany et al., 2014). As has been recognized for other languages (Dorian, 1981; Gal, 1979; Grenoble, 2011; Hill & Hill, 1986; Kroskrity, 2011; Kulick, 1992),

such marginalization, along with racism and bullying (Bax, 2020; Perez et al., 2016), may lead to or accelerate language shift.

Unfortunately, little is known about language maintenance and shift in Indigenous diasporic communities (but see Bax, 2020; Falconi, 2011, 2013; Moreno Villamar, 2022; Pérez Báez, 2012, 2013, 2014). Presumably rates of language shift are similar to those in non-Indigenous diasporas, in which language maintenance is rare beyond two generations, unless speakers from home communities continue arriving (Brenzinger, 2007; Lam, 2008; Veltman, 1983). This has been argued for diasporic Zapotec in Los Angeles where youth may make different language choices than their parents (Pérez Báez, 2009), but parents may also have agency and impact towards cultural and linguistic maintenance (Martinez & Mesinas, 2019). For the most part, linguists have ignored Indigenous immigrant populations, under the assumption that the contexts of Indigenous language use in diaspora communities are reduced: traditional activities may not be carried out, the conditions for ceremonial language may be lacking, and taxonomies may be hard to reconstruct without referents at hand (Kaufman & Perlin, 2018). These views ultimately rely on ideologies of Indigenous linguistic and cultural authenticity (Henze & Davis, 1999) and result in Indigenous diasporas being deemed not suitable for documentary linguistics in the traditional sense, or for language work broadly construed (for some exceptions see Caponigro et al., 2013; Carroll, 2015; Lillehaugen, 2006; Peters, 2018; Ventayol-Boada, 2021; inter alia).

For Indigenous migrants, language is often central to a person's identity and essential for cultural continuity (Blackwell, 2017; Uliasz, 2018). Language maintenance correlates with higher degrees of cultural involvement (Mesinas & Pérez, 2016) and has been shown to be associated with better indicators of health and wellbeing (Biddle & Swee, 2012; Hallet et al., 2007; Oster et al., 2014; Taff et al., 2018; Walsh, 2018). This is the case in the context of Nahua communities in Mesoamerica (Olko et al., 2021), and presumably the same applies in diaspora contexts, where the sense of urgency for Indigenous language access and language maintenance may be amplified. Ultimately, maintaining Indigenous languages in the diaspora is a key facet of linguistic and social justice (Uliasz, 2018).

One of the strategies available to support language maintenance in the diasporic context is digital technology, which has gained traction in recent years among speakers of Indigenous and endangered languages in general. Examples include online dictionaries (e.g., Genee & Junker, 2018; Littell et al., 2017), automatic speech recognition (e.g., Anastasopoulos, 2019; Foley et al., 2018), morphological analyzers and transducers (e.g., Bowers et al., 2017; Moeller et al., 2018; Washington et al., 2021), virtual reality (Running Wolf et al., 2020), and so-called serious games (*Never Alone/Kisima Injitchurja*, 2016; West et al., 2019) to name a few. Digital technology and the Internet have created new spaces to support maintenance and revitalization efforts (Avila, 2021; Begay, 2013; Eisenlohr, 2004; Elliott, 2021; Galla, 2016, 2019) and have opened the door for new domains of language use to emerge

(Cassels, 2019; Lillehaugen, 2016, 2019; Scannell, 2012). In diaspora communities, leveraging digital technologies to support language maintenance is especially relevant, as they become crucial tools for creating social connectivity (Harrison et al., 2019; Tsagarousianou, 2004). The multiple associations and intersections provided by cross-media platforms allow people to maintain existing ties with their home communities and establish new connections across diasporas with individuals they did not previously know (Ponzanesi, 2020, Salazar et al., 2021). This connectivity is fundamental to rebuild interactive networks among those who wish to maintain their language. Without these networks, goals of language maintenance or language revitalization are often unachievable (Sallabank, 2010).

The use of technology for language maintenance especially engages youth, who tend to be technologically literate and active users of computers and handheld digital devices, such as smartphones and tablets. Given Indigenous youth's role as agents of language maintenance (Bax, 2020; Lee, 2009; McCarty & Wyman, 2009; Messing, 2009; Nicholas, 2009; Wilson & Kamanā, 2009; Wyman, 2009), it is important to use platforms and media that they interact with. Digital technology as a whole, and social media in particular, generate recognition in the present, which helps to counter ideologies of Indigenous languages as being 'archaic,' 'backwards,' 'lacking,' or 'a relic of the past' and shows that all languages are relevant and belong in the contemporary world (Bird, 2008; Brandt, 1988; Eisenlohr, 2004; Lillehaugen, 2019; McHenry, 2002).

One approach that capitalizes on digital technology for learning is gamification. Gamification can be defined as the use of game design elements and principles in non-game contexts. It is often used as an online marketing technique to encourage engagement with a product or service, but over the last decade gamification has become a popular strategy to promote learning, as it can foster interest and motivation for a more meaningful and enjoyable learning experience (Dicheva et al., 2015). Gamifying the learning process is not a new strategy, as analog gamified activities such as flashcards have been used for a long time, but its popularity has increased due to the proliferation and creative flexibility of digital technologies and media. Gamification is different from approaches that facilitate learning exclusively by means of games, such as game-enhanced learning, which promotes acquiring soft skills like problem-solving and decision-making through commercial games that are not designed for educational purposes, and game-based learning, which is purposefully designed to deliver a specific skill or knowledge following a storyline with a beginning, gameplay, and an end state (Al Fatta et al., 2019; Reinhardt & Sykes, 2014; Whitton, 2012). In a nutshell, the user of a gamified activity can be thought of as a learner, whereas in game-enhanced or game-based learning they are essentially a player (Opacki, 2022).

One of the advantages of gamification over non-gamified learning is that it allows a more scaffolded and interactive experience for the user/learner by encouraging targeted repetition (Hitosugi et al., 2014). Specifically, gamification has been shown to improve engagement (Ding et al., 2017;

Hew et al., 2016), motivation (Bicen & Kocakoyun, 2018; Bovermann & Bastiaens, 2018), and satisfaction (Barna & Fodor, 2017; Chan et al., 2017) among learners. Gamified activities typically start by offering basic challenges to the user/learner, and as they acquire more knowledge, the difficulty gradually increases. Incorporating these strategies reduces learner frustration, anxiety, boredom, and ultimately, drop-off (Nakamura & Csikszentmihalyi, 2014).

In the context of second language acquisition, gamification offers strategies to offset some of the more repetitive tasks that are typically less engaging (Purgina et al., 2020). Crow and Parsons (2015) argue that well-designed gamified experiences encourage learners to repeat activities until they can achieve their desired outcome and improve their performance; similarly, Galvis (2015) and González Piraján (2017) show how the process of learning vocabulary, which is often perceived as daunting and repetitive, can be improved through interaction with digital tools and games. Importantly, the effects of gamification on the language learner's motivation are impactful (Iaremenco, 2017; Reynolds & Taylor, 2020; Zarzycka-Piskorz, 2016; Zou, 2020), as the process of language learning requires sustained commitment over time.

Nevertheless, the design of digital materials as a whole, and with a gamification approach in particular, requires technological expertise and resources not yet available to many community members and not yet mastered by many linguists (Cope & Penfield, 2011; Nathan & Fang, 2008; Penfield & Tucker, 2011; Salazar et al., 2021). These issues paired with the perceived costs associated with developing gamified materials—and digital games more broadly—have contributed to these resources remaining rare in language revitalization and language maintenance initiatives (West et al., 2019). Bridging this gap requires, on the one hand, establishing partnerships between linguists, community language workers and digital instructional designers, and, on the other hand, using off-the-shelf, readily available resources to reduce costs and produce materials within a limited budget. Let's Learn Mixteco provides an illustrative example of such a project.

3. LET'S LEARN MIXTECO PROJECT MEMBERS

In Ventura, Santa Barbara, and San Luis Obispo Counties, the community organization MICOP (Mixteco/Indígena Community Organizing Project) aims to serve a population of at least 35,000 Californians of Indigenous Mexican descent. The diversity of the Indígena community helps shape collective panethnic identities, while peoples' links to their hometowns in Mexico reflect the fluid and dynamic notion of community in this context (Reyes Basurto et al., 2021). MICOP's mission is to “support, organize and empower the Indigenous migrant communities in California's Central Coast,” and towards this broad goal, MICOP offers a variety of services to aid community needs, ranging from interpreting to reproductive health education, Spanish and English literacy classes, adult education, and many others. In addition, it hosts the multilingual and multi-variety radio station Radio Indígena

and sponsors the activist youth organization Tequio. In general, MICOP's language-related goals include improving language access for linguistic and social justice, which entails better understanding of which languages and varieties are spoken in the community, and respecting and maintaining Indigenous languages as part of individual and community identity. However, there is no monolithic view or explicit statement of the broader community's language-related goals.

In 2015 MICOP partnered with the Department of Linguistics at the University of California, Santa Barbara (UCSB) to create a range of programs to support language maintenance, literacy, and social justice in the community (Campbell & Reyes Basurto, in press; Hernández Martínez et al., 2021). Team members offer Indigenous literacy classes and train Indigenous community members interested in becoming literacy instructors. Four community members have taken part in the biennial year-long graduate field methods course at UCSB within a collaborative, community-based language research paradigm (Cruz & Woodbury, 2014; Czaykowska-Higgins, 2009; Sapién, 2018). In this environment, graduate students and community members gain skills together, while the outcomes of the documentation process are shaped by the goals of the community members and the skills of the collaborating linguists (Campbell et al., 2021).

Additionally, the field methods classes serve as a spring board to ongoing collaborations, which are not defined in any formal agreement, except when part of a funded grant proposal. The work can be characterized as a dynamic constellation of smaller and often overlapping subprojects, each with broad goals typically envisioned by one or multiple community members and led by them or university linguists. It is important to keep in mind, however, that these sprouting subprojects involve individuals with different priorities and languages goals (e.g., language interpretation in public schools, language access in health or legal contexts, documentation of anatomy and botany terms, language literacy for adults, etc.). Even as many Indigenous languages workers collaborating with UCSB have worked in some capacity at MICOP, no individual can represent all of MICOP, and MICOP does not claim to represent the individual goals of everyone in the community.

The Let's Learn Mixteco project originated in the 2017-2018 field methods course led by Eric; Carmen took part as the language consultant; and Albert was one of the graduate students in the class. Collectively, the class engaged in the documentation and description of Carmen's Mixtec variety from San Martín Durazos: Tù'un na Nuu Sá Matxîi Ntxè'è. The practical orthography developed in the class under Carmen's guidance is in line with Guadalupe Joaquina's (2014) proposal and the Ndusu Tu'un Savi alphabet chart, but it includes a few modifications that represent specific characteristics of the variety, such as sibilant contrasts that are not common among Mixtec varieties (palato-alveolar <sh> /ʃ/ and <ch> /tʃ/ vs. alveolo-palatal <x> /ç/ and <tx> /tʃ/). The development of pedagogical materials was central from the very beginning in service of the community's goals (Grinevald, 2003; Mosel, 2012; Nathan & Fang, 2008; Yamada, 2011), and Camen and Albert started

working closely toward that end. To support language maintenance, it was necessary to engage with youth in the community, and technology was an important tool to achieve that goal. However, both Carmen and Albert still lacked the technological expertise to develop digital pedagogical resources. It was at this point that John, a graduate student in Education investigating digital instructional design, joined the project. John brought his crucial expertise for developing online pedagogical materials to the project.

From the start the team's goal was to develop a website with digital pedagogical materials that are culturally-responsive, and accessible, that require little technical expertise to create, and that would engage youth in the community. For the cultural appropriateness of the materials, we adopted an approach that respects Indigenous epistemologies (Leonard, 2021); for accessibility and lowering the technological barrier, we used free-to-use online platforms with existing templates and drag-and-drop functions that do not require interacting with code. Finally, to engage the youth in the community we used social media platforms that they often interact with (mainly YouTube and Instagram), and gamification strategies that support language learning and make the acquisition process more fun.

With this multi-pronged goal in mind, we established the cornerstones of our collaboration by defining the roles and identifying the tasks that each team member could best carry out. As the community member, Carmen envisioned and shaped the pedagogical materials from the very beginning and brought in her inside knowledge of the community in Oxnard, as well as her home community in San Martín Durazos. This was crucial to respect existing practices and cultural norms in the community (Galla, 2019), by incorporating Indigenous epistemologies that reflect the categorizations in the language. One of the ways in which this manifested is the organization and presentation of knowledge in collections of activities by semantic field. For example, vocabulary related to fruits is organized and presented to the learner separately from other food items, thus following the taxonomies relevant for the speech community. Carmen carried out the scriptwriting of the materials: this task involved both eliciting examples and drafting dialogues of everyday situations that reflected the use of the language in context. More broadly, this task also involved determining the content to include with the materials and when to present them to the learner based on their cultural relevance. As we prepared to record the materials (see Section 5), Carmen recruited additional community members to participate in dialogues with her, and she directed, staged, and performed in the video recordings.

As the digital instructional designer, John supported the technological and pedagogical aspects of the project. His inside knowledge of the educational technology sector informed our decisions on the tools and resources we used in order to lower the technological barrier associated with producing digital pedagogical materials and to reduce the project costs resulting from this process. John suggested the platforms to design both the activities and the website, and he shared with the rest of

the team several online repositories of royalty-free resources for designing video content. He also contributed to most tasks involving multimedia materials: from video recording to video editing, to managing a video channel on YouTube, to building and maintaining the website. In addition, John supported the pedagogy behind the activity design with a gamified approach to language learning and led the creation of documentation that captures the materials' production process. The result is a project-internal how-to manual that enables any current or future team member to create similar materials by following the same steps.

Finally, Eric and Albert worked on the project in their capacity as linguists. While they shared several project tasks, they brought in complementary skills given their backgrounds. Eric's work in Otomanguean linguistics (Campbell, 2016, 2017a, 2017b) informed the early stages of the documentation process and the linguistic analyses. This background information shaped the pedagogical materials in several ways, especially in the representation of tone in the practical orthography. Additionally, Eric ensured that the difficulty level of activities increases steadily and thus avoids learner frustration, anxiety, boredom, and potential drop-off. Albert's background in second language teaching, and especially in developing teaching materials for under-resourced languages, was important in formulating the goals of individual activities and in shaping the broader scaffolding of the project. In addition, as the project facilitator he was involved either primarily or secondarily at every step: from scriptwriting support to adding entries in the lexical database, to video recording and editing, to implementing gamified activities, to developing the website. As a result, Albert was able to coordinate among team members, facilitate discussions, and check-in as each task developed. In addition, he led the applications for grants to fund the project and worked as the point of contact with third parties to establish partnerships (see Section 3.3).

While each task was led by one (or more) primary team member(s), the entire team was involved in envisioning each task and shaping the project. This structure generated a conducive environment for ideological clarification (Dauenhauer & Dauenhauer, 1998) both for Carmen as a community language worker but especially among the team including outsider collaborators (Kroskrity, 2009, 2015), in order to define everyone's expectations and be explicit about assumptions, goals and outcomes at each stage of the project (see Figure 1). This workflow created spaces for training and mentoring, with each member in the team actively sharing their knowledge and skills with the rest: from video recording and editing to website development, elicitation, and tone analysis. These spaces also allowed us to incorporate several undergraduate research assistants at different stages and to offer them training and research mentoring outside the classroom.

Ultimately, the goal of building such a structure was to make the project less dependent on the skills of specific people, especially the non-Indigenous team members. The low-level technological skills needed to design the digital pedagogical materials, the low-cost technologies, and the ongoing

language documentation activities allow the project to be sustainable over time, making it possible to incorporate new team members and eventually expand the materials to other varieties of Mixtec spoken in Oxnard and Santa Maria if desired.

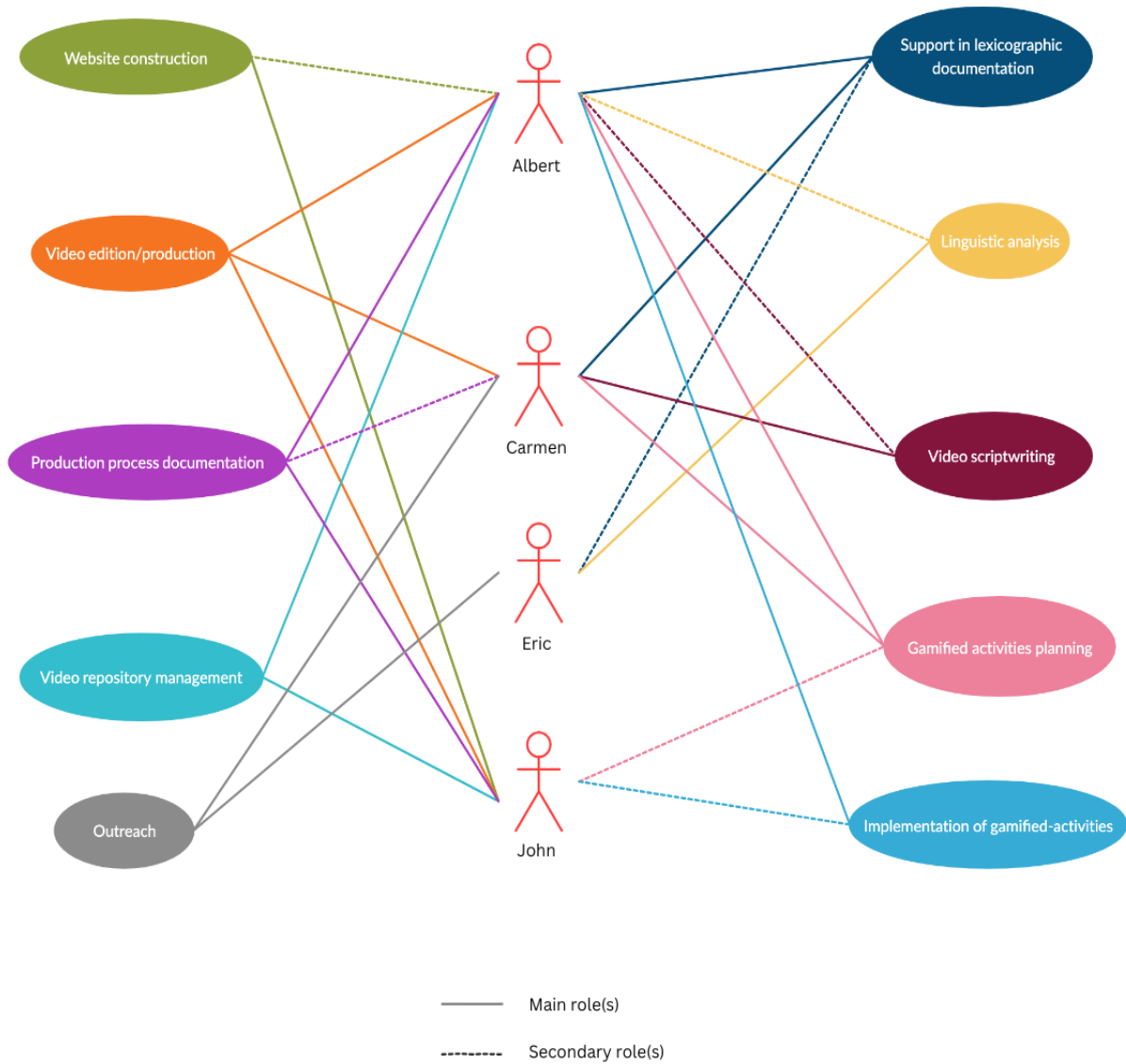


Figure 1: Project members' participation in activities executed

4. METHODOLOGIES AND TECHNOLOGIES FOR DIGITAL GAMIFICATION

As already mentioned, the objective of the Let's Learn Mixteco project is to support language maintenance in the Mixtec diaspora community in California's Central Coast through free-to-use digital instructional resources integrated on a single website. Figure 2 summarizes the steps we took for generating the materials and the gamified activities, and which follow Huang and Soman's (2013) five-step model of educational gamification. In this section, we discuss the first three steps of the process: (1) understanding the target audience, (2) defining learning objectives, and (3) identifying free-to-use digital resources. In Section 5 the last two steps are discussed: (4) generating materials, and (5) generating gamified activities.

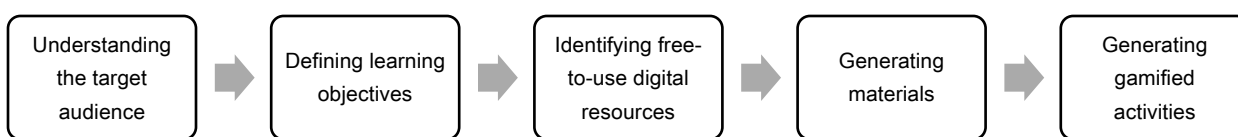


Figure 2: Five-step model for educational gamification, adapted from Huang & Soman (2013).

As we started our collaboration, the long-term goal was for the website to become a digital repository of multilingual and multivarietal materials for the Mixtec community in California's Central Coast. Thus, originally the website was conceived not to include only the pedagogical materials directly derived from this project, but also any materials that would result from the ongoing partnership between MICOP and UCSB Linguistics. These could include a variety of resources already planned, currently in development, or now finalized, such as alphabet charts in different varieties, sketch grammars, single and multi-variety dictionaries, and multilingual materials for printing such as children's coloring books and *lotería* (bingo) games. This long-term vision had a direct consequence: any technologies to be used for the development of pedagogical materials needed to be flexible enough to develop parallel resources in other Mixtec varieties as the project developed over time and incorporated more community members.

Our short-term goal was to help youth strengthen their connection with their linguistic and cultural heritage in the community. Here "youth" is understood broadly: the target learners for the materials we developed span roughly from 7 to 16 years old. Thus, our initial learning objectives have so far revolved around developing and implementing materials around basic vocabulary and daily phrases, with more advanced materials to follow. Specifically, activities focused on one of two learning objectives, that is, introducing lexical items and phrases, or reinforcing what the learner had already come across. The latter typically involved a game component (e.g., matching words to depictions of their meanings in

pictures), whereas the former learning objective was carried out through video-based exercises, as explained in Section 5.

There are several applications and software readily available online that allow designing digital resources and gamified activities. We selected Educaplay, a free-to-use online platform with predesigned templates for gamified multimedia activities—including matching games, crosswords, dictation, and video quizzes, among others, drawing from a repository of games made by different users. The activities it offers can be used as reinforcement exercises, evaluation tools, and motivational devices, and they have been applied at all levels of education, from kindergarten to university (Garrido Astray et al., 2019; Páez-Quinde et al., 2022). Educaplay is not specifically designed for language learning, but this is its most popular use among educators, with over 750,000 games for 21 languages, including some under-resourced languages like Asturian, Aragonese, and Basque.

Educaplay was a good fit for our goals for several reasons. First, it is user-friendly, with a quick and short learning curve to create activities: each activity type comes with a template that is easily adapted to create the game. This feature fulfilled our need to limit the technological expertise required for the resource design process. Second, the wide variety of activities it offers enabled us to address different components of language, from spelling to vocabulary to basic grammar. Third, activities can be duplicated. This feature allows us to scale the project with relative ease, since activities can be easily duplicated and modified to represent other varieties spoken in the community. Fourth, activities are all mobile-friendly (i.e., usable on smartphones and tablets), which is critical given that smartphone use now exceeds desktop traffic (Statista, 2023), and around 85% of teenagers in the U.S. use smartphones to access the Internet (Cheever et al., 2018). To help gain early momentum, an assignment was developed in the Field Methods course requiring each student to create and publish an Educaplay activity with Carmen.

Finally, Educaplay's web interface is available in Spanish and English (as well as French), which gave us the opportunity to offer the games in the learner's preferred language, since as mentioned in Section 2, knowledge of Spanish and English varies within the diaspora community and across generations. For the activities themselves, we partnered with the team behind Educaplay to implement a translation of the user interface into Carmen's Mixtec variety to set up an entirely immersion-based learning experience, with instructions and buttons displayed in the language. However, after Educaplay's latest user interface changes, these are unfortunately no longer available. Figure 3 shows an example of the title screen for an activity to learn body part terms with the Spanish interface.

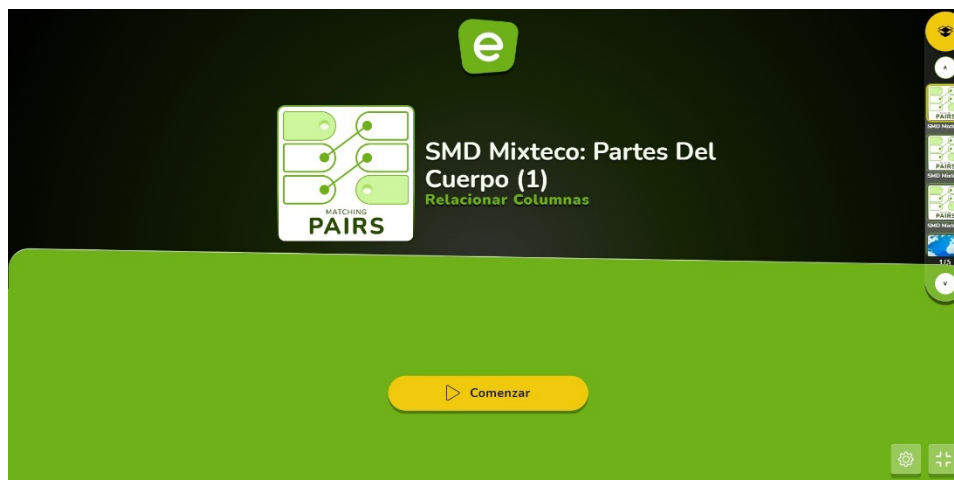


Figure 3: Example of a Let's Learn Mixteco title screen activity designed with Educaplay. The interface is displayed in Spanish, with the related activities in the collection appearing vertically on the top-right.

5. GENERATING MATERIALS AND GAMIFIED ACTIVITIES

Following Huang and Soman's (2013) five-step model, the last two steps in the project implementation (see Figure 2 above) are creating multimedia materials and developing gamified activities. These might seem equivalent, but it is important to distinguish between the two. Multimedia materials refer to the resources developed to be used for generating the gamified activities. These include videos, images, audio-recordings, and so on. Gamified activities, on the other hand, are the end product presented to the user/learner on the project's website and developed with the multimedia materials on Educaplay. While these two steps are conceptually sequential in nature, in our workflow producing the multimedia materials was always preceded by a discussion of the activities to use on Educaplay. In other words, the generated materials were crafted according to the activities we wanted to create. Figure 4 summarizes this workflow.

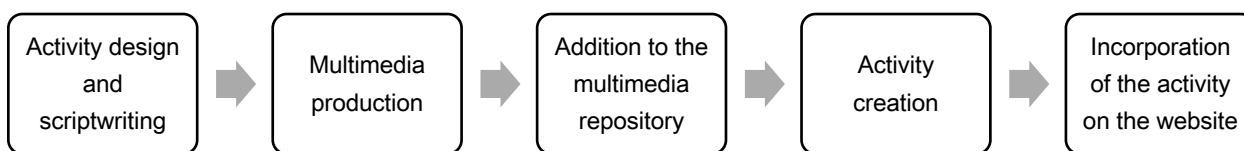


Figure 4: Workflow for generating materials and gamified activities for Let's Learn Mixteco.

First, the design and scriptwriting of activities consisted of establishing the goals and outcomes of each resource to be created (e.g., introducing the learner to terms for clothes). This process followed the guiding principles outlined in Section 3, and it typically involved a discussion among all team

members in order to ensure that the materials were culturally appropriate and relevant, while at the same time making sure that the difficulty level of the materials increased gradually and thus supported the users' learning. Importantly, this process also informed and contributed to the ongoing language documentation effort, as we often ran across lexical items that were missing in our lexical database and discovered morphosyntactic constructions when crafting dialogues that were not present in our corpus of audio recordings. In the scriptwriting process, we leaned heavily toward Educaplay activities that supported multimedia resources. It was important to us that the learners/users had visual and audio stimuli in order to facilitate the acquisition of sounds in Mixtec and reduce the presence of the two contact languages and thus create a learning experience that was as immersion-based as possible.

For the video production process, we used a green screen that allowed the creation of layers inside the video (e.g., pictures, text, etc.). All the resources used in the production were low-cost: the green screen was a large piece of green fabric we bought at a local flea market and pinned onto a wall wherever we were recording, and ordinary lamps were used for lighting. After recording, we used the preinstalled Mac video editing app iMovie to replace the green screen background with a black monochrome one. This decision was made because a dark monochrome background allows on-screen text to be more visible to the viewer. After that, we incorporated into the video an edited template we developed in parallel using Microsoft PowerPoint. The template included the words spoken in the video written in the practical orthography, as well as pictures that depicted the meanings of the words. These were high-quality, royalty-free images that were culturally appropriate for Mesoamerica, and the majority came from the database at the formerly available online Laboratorio Internacional de Materiales para la Enseñanza y Difusión de Lenguas Amerindias (LIMEDLA). We also extracted the audio content from videos and repurposed it in activities that were audio-only. Additional audio recordings were made with personal cell phones and later converted to more portable formats like MP3 and WAV.

At the end of the production process, all video materials were uploaded to the project's YouTube channel. The reason we used YouTube is that Educaplay's video-based activities can be built with a link from the video sharing platform, and it also served as our interim video repository before archiving the resources at the Endangered Languages Archive (Auderset & Hernández Martínez, 2021). For each video, a decision was made whether it should be labeled for public access or not. This decision was usually made on the basis of the video's purpose and length: short-length (i.e., around two seconds) single-word vocabulary clips were labeled as "not public" since they were used as resources for the learning activities, while longer vocabulary videos based on a single topic (e.g., animals, numbers, etc.) were made accessible to YouTube users and labeled as "public".

Next, we created each activity on Educaplay's platform. Video-based activities introduced learners to new vocabulary and were created with YouTube URLs from the non-public pool of video resources.

Crucially, we disabled related videos being shown at the end of each video by adding the tag *&rel=0* at the end of the YouTube URL. This edit allowed us to avoid distraction and focus the learner's attention on the content just presented. Non-video-based games (e.g., puzzles) were created with Educaplay's templates with the same exact lexical items included in the video-based activities, and their goal was to reinforce the acquisition of these words. Figure 5 displays a non-video-based matching activity in which learners are asked to connect each image with the corresponding word for each animal.

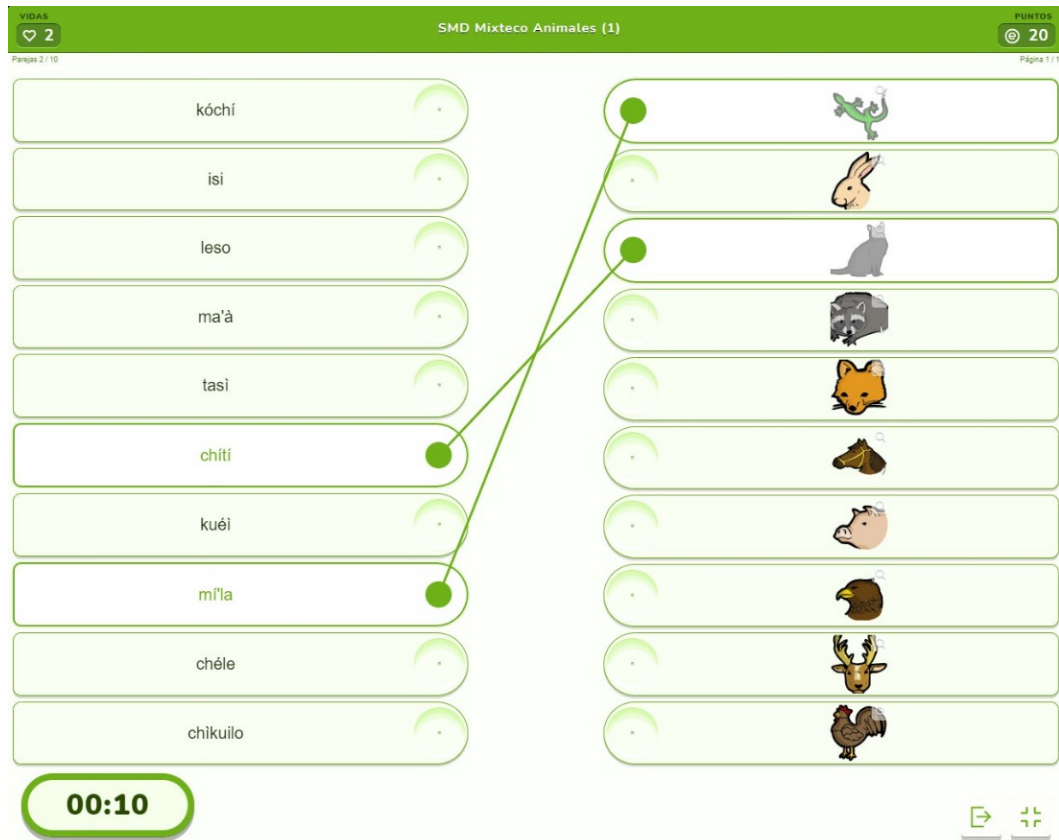


Figure 5. Example of a Let's Learn Mixteco activity designed with Educaplay (Spanish interface)

Activities were organized in collections around semantic fields that match the publicly available, single topic vocabulary videos on the YouTube channel. Typically, each collection starts with a video-based activity followed by a non-video-based game. Learners can easily jump across activities within the same collection through a drop-down menu on the top-right corner of the screen, as seen in the top right of Figure 3. Learners have freedom of choice here, since they can navigate to whatever activity in the collection they want to use. The idea, however, would be to follow the activities in a linear order, since each activity typically relies on mastering the content from the preceding one.

The strategy of presenting vocabulary in video-based activities first and then in non-video-based ones allowed us to develop a step-by-step difficulty increase. For example, in the collection for fruit terms, the learner first encounters seven short videos with seven fruit images, their pronunciation, and their spelling in the practical orthography. They can spend as much time as they want on each word and listen to it as many times as they want. In this particular example, the next activity will ask the learner to match the name of the very same seven fruits to their images, similar to the matching of animal names to their meaning in Figure 5. With this design, users can face more challenging activities as they develop their skills and knowledge in Mixtec.

Finally, after the creation of each activity, these were incorporated on the Let's Learn Mixteco website that we developed in parallel. The integration is intuitive, since Educaplay automatically allows the activity to be embedded in a website. If the activities are organized in collections, as we did, this operation only needs to be carried out once for each collection. Similarly, if any changes are made on the activities on Educaplay's platform, these will automatically be reflected on the website where they are embedded. With respect to the website itself, we used Wix, a website builder with templates, drag-and-drop tools, and an intuitive user interface. Like Educaplay, the choice of Wix served us to lower the barrier to technology by reducing the level of technical expertise necessary for website development. However, Wix's free-to-use version does not allow editing the website's URL. For that reason, we are currently in the process of migrating all the resources to GoogleSites, which does not have pricing tiers and it only requires one to purchase a domain (averaging \$10-\$20/month) in order to have a simpler URL. Otherwise, Wix offered us enough functionality for the purposes of our project.

6. REFLECTIONS ON THE PROJECT

In our experience, this project's organization and workflow has several strengths. First, the project is fully community-driven: Carmen's role as community language expert has remained central in all planning, creation, and dissemination. As a result, the pedagogical materials that we designed reflect community, and not external, values and norms. This can be observed, for example, in the organization and presentation of materials on the website, which follow the concepts and taxonomies relevant in Mixtec language and culture. In addition, the material development process informed and complemented the ongoing documentation of Carmen's variety. While the project is not currently fully community-led, our workflow enables the project to become so without creating additional burdens to community language workers, and it allowed us to create spaces for training and mentoring in order to make the project sustainable in the long run and not dependent on the skills of the non-Indigenous team members. A fully community-led project could look similar to this one, perhaps with outsider linguists serving only as consultants, or perhaps no longer involved. An example of this exchange

among team members is the project-internal how-to manual for multimedia production that enables new team members to create similar materials by following the same steps.

Second, the tools used in the project have lowered the financial resources that would otherwise be necessary for such work. While currently there are several platforms available for gamified learning and website development, Educaplay and Wix proved to be the most user-friendly for us at the time, but the technology and tools change rapidly. High usability with drag-and-drop features lowered the technological barrier for the development and maintenance of the website-based resources.

Third, the flexibility of the tools we used proved to be very helpful. On the one hand, it allowed us to incorporate a variety of multimedia resources, such as audio and visual stimuli. On the other hand, it enabled us to adapt quickly as our goals changed. Throughout the life of this project other collaborations between MICOP language workers and UCSB linguists started to materialize. These partnerships focus on different language varieties, adopt distinct pedagogical approaches, and have created websites of their own (Gabriel Ruiz et al., 2022; Salazar et al., 2021). Thus, we revisited the original goal for the website as a community-wide repository and decided to center it around Carmen's Mixtec variety instead, while leaving the door open to scale the project in the future by incorporating other varieties in the community if there is interest in generating materials through gamification.

Despite the many strengths and benefits of our model, we faced several challenges throughout the project's design and implementation. First, our workflow and methodology rely heavily on third parties. Specifically, we rely on their continuous support and maintenance of their software. For example, Educaplay originally implemented a translation of their interface into Mixtec but later discontinued it for reasons unknown to us. Similarly, we are restricted by the features their software allows. Certain Educaplay activities do not display accent marks or do not allow accents to be typed in. While the team behind the platform is working to change that, it limits the number of activities we can currently make use of for Mixtec, since diacritics are used in the practical orthography to represent tones in the language.

In addition, we are not in control of what third parties might do with the resources and materials hosted on their platforms, a situation that raises questions about intellectual property and Indigenous data sovereignty (Kukutai & Taylor, 2016; Walter & Suina, 2019). YouTube is part of the Alphabet Inc. Corporation (i.e., the parent company of Google and its subsidiaries), and, as a private entity, it has its own political and economic agenda; their values and objectives do not necessarily overlap with those of language conservation efforts. Additionally, YouTube can analyze the content of videos regardless of their visibility settings, remove them from the platform, and even retain copies of videos after their creator removes them (Rice, 2021). YouTube's right to analyze video content upon upload to their platform can be particularly problematic, especially considering the surge of Generative

Artificial Intelligence applications and their risk to reproduce extractive and exploitative practices towards Indigenous communities (Lewis, 2023; Whaanga, 2020).

Similarly, a heavy reliance on third parties carries issues of portability and file maintenance in the long run (Bird & Simons, 2003; Nathan, 2006). In our view, using YouTube as a repository cannot be a substitute for more properly archiving the multimedia materials generated for the gamified activities. Archiving in a digital language archive, as we did, is crucial to ensure that the audio and video files will remain available and will be migrated to new formats, even when for-profit private third parties may discontinue their support for multimedia files that they deem are not worth maintaining.

Another important challenge we faced is engaging youth to fully participate in different aspects of the project. We tried to involve Tequio, the youth organization at MICOP that fosters youth leadership skills and social justice activism, but their involvement did not fully materialize, due in part to the lack of funding to support their efforts as well as demands on their time from other important priorities. Similarly, launching and promoting the website in the wider community has been difficult, and use of the activities has been relatively low so far. These two issues have hampered our efforts to carry out a beta testing of the materials to ensure that instructions were easy to understand and whether learners enjoyed the gamified activities and their organization, and, as a result, we have put the evaluation of the materials on hold until we can build momentum around the project again. We believe that there are two reasons for these obstacles. First, disruptions due to COVID and other factors brought about internal restructuring in the community's regular meetings that made it difficult for us to have a platform to display and promote the project as it unfolds. And second, maintaining a steady and sufficient stream of funding to support an online community manager that uses Instagram, Snapchat and Facebook for outreach and website promotion is a challenging and unpredictable process.

Focusing too much attention on the deliverables, however, can be counterproductive for language revitalization projects. As Ávila Molina and Ospina Bozzi (2022) point out, failure to launch specific products in such projects can discourage those involved from continuing to work towards revitalization, even if the barriers faced could not be anticipated or were external to the project. Instead, they argue for a shift of attention towards the *process* of revitalization itself, in which the goal is to build the steps for increased language use rather than delivering specific end products. In this view, an evaluation should focus on the relationships and the systems built in the project.

With this in mind, we performed an assessment of the collaboration and the project structure based on the key principles of collaboration in team science (Bennett et al., 2010). In our assessment, our relationship indicators scored high, especially in the categories of communication, level of trust, openness and ability to work as a team. Performance indicators ranked lower on average. The assessment showed that keeping on schedule and overcoming barriers were the biggest challenges

we faced. These issues are related, in part, to the resources available to the project. As mentioned, lack of funding prevented us from onboarding additional team members with specific tasks, such as outreach or video editing. Undergraduate research assistants were crucial in this respect, but their commitment to the project varied. Meeting the project's goals and deadlines thus turned out to be challenging without more stable supporting roles. Overall, the project evaluation revealed which areas we need to focus on as we move forward.

7. CONCLUSION

In this article we have presented the collaborative model behind the Let's Learn Mixteco project, whose main objective is to support language maintenance in the Mixtec diaspora communities in California's Central Coast. Language documentation projects and revitalization initiatives with Indigenous communities living outside their ancestral lands have not been a traditional focus in language work, although there has been some shift in recent years to acknowledge the changing landscape of language maintenance and revitalization. For example, in California a variety of projects are underway or have been carried out with communities of Mesoamerican origin at UC Santa Cruz (e.g., Nido de Lenguas), UC San Diego (e.g., Carroll, 2015), UC Santa Barbara (e.g., Hernández Martínez et al., 2021), and UCLA (e.g., Lillehaugen, 2006).

As diaspora communities organize to preserve their cultures and languages, technology offers a window of opportunity to support their linguistic journeys. This is especially relevant given the current surge in technology-related research on and applications for Indigenous languages, which range from dictionaries and spell-checkers to morphological analyzers and virtual reality. Similarly, there is an increasing number of free-to-use tools for literacy development, such as *Storyweaver* and *ReadAlong Studio* (Littell et al., 2022).

For language learning, gamification is gaining traction. The gamification of the language learning process is not new, and there are many examples in an analog format (e.g., Ávila Molina & Ospina Bozzi, 2022; Ospina Bozzi, 2015). Paired with technology, however, gamification offers a more dynamic experience that can enhance the motivation for a learner to achieve their goals. Additionally, current free-to-use technologies and royalty-free media facilitate the development of digital materials without large amounts of funding. However, documentary linguists are rarely trained in digital instructional design and therefore may struggle with incorporating such resources into documentation and revitalization projects.

The Let's Learn Mixteco project is built on a partnership among one community member, two linguists, and one digital instructional designer. Our goal was to develop digital pedagogical materials using gamification strategies for language learning that are culturally-sustaining and which require little technical expertise to create. This project presents a vision and a step-by-step model for the creation

of digital tools for language advocacy and learning that are both accessible and economical. However, it does entail using third party entities, which introduces ethical concerns about data sovereignty and exposes teams to changes that they do not initiate or desire, such as the removal of the Mixtec user interface on Educaplay that we experienced. We believe that this model might be especially interesting for other diaspora communities in which access to technology and the Internet is not a problem and creating materials and spaces for language use and language maintenance is a desire. Ultimately, we offer a guide to reproduce or adapt a project that incorporates instructional design and digital gamification to language maintenance, and we hope to inspire similar projects in other language contexts.

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