FC S125

TewaTalk

Preserving the Tewa Language through Mobile Technology

An Interactive Qualifying Project submitted for review to the faculty of

WORCESTER POLYTECHNIC INSTITUTE

Submitted by:

Virginia Bell

Matthew Fusco

Karin Greene

Andrew O'Neill

Project Advisors:

Dr. Fabio Carrera, WPI Professor

Dr. Guillermo Salazar, WPI Professor

E-mail: sf12-lang@wpi.edu

Project Website: https://sites.google.com/site/sf2012lang/

TewaTalk Website: https://sites.google.com/site/tewatalk/

Abstract

The governmental and societal push for universal languages, known as a "language shift," causes countries to rely on universal languages for communication over indigenous languages. As a result, the Tewa language, spoken by six Indian Pueblos in New Mexico, has been slowly declining over the last century. The goal of this project was to contribute to the preservation of Tewa by designing a mobile application and a supplementary website that would aid in language education. Detailed interactive mockups were first designed to help visualize the final products. The application was then programmed for the Android platform, and the website was created with Google Sites. After extensive prototyping and testing, we created a polished, functional application and an interactive website design with learning tools.

Executive Summary

The decline of languages across the globe is an issue that is worsening as time goes on. Currently, there are 6,900 languages spoken worldwide. Of these, up to 90% are predicted to become extinct by the end of the century. In many native communities across the United States, language decline is prevalent. With English being the dominant language, indigenous tongues have begun to die out. Native children have stopped speaking the languages of their people and parents have stopped teaching them. The Pueblo of Pojoaque just north of Santa Fe, NM is experiencing this exact problem with their native Tewa language. Tewa is spoken in six Pueblos in New Mexico, all of which are experiencing a decline of native speakers, but Pojoaque has one of the lowest number of total speakers in relation to overall population. The goal of our project was to work with the Indigenous Language Institute (ILI) and the Pueblo of Pojoaque to help resolve and potentially reverse this loss of the Tewa language by creating a smartphone application that preserves the language by collecting and streaming voice recordings based on a script customized specifically for Tewa. In addition to the application is a design for an educational website that has all the features of the application plus more to prevent users without smartphones from being unable to access our material.

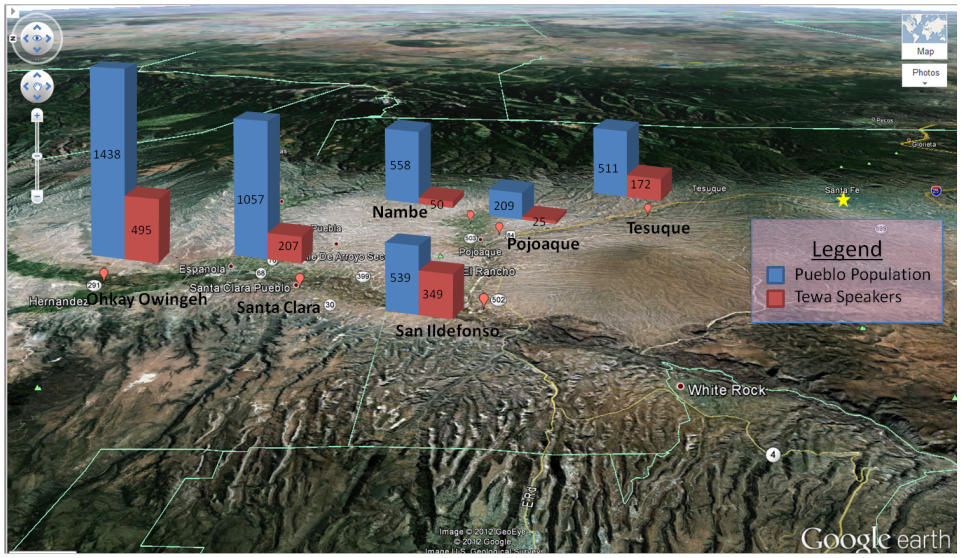


Figure 1: Map of population size and number of speakers of Tewa in New Mexico Pueblos based on 1991 United States Census

The team designed the application, called "TewaTalk", to have six features – the main two being "record" and "browse". The "record" feature allows the user to submit recordings as well as

additional information such as a written description of the entry in English and in Tewa, the dialect spoken, the gender of the recorder, and any additional notes. The user can then submit the recording to be uploaded to a server, or add it to a queue for later submission. The "browse" feature lets users view the 25 categories in the script and all of the entries for each category. Recordings for any entry and their corresponding information can be accessed using this feature, as well. TewaTalk is an Android application, and will only work with devices that have Android-based operating systems. To create the app, the team altered source code from another application from a previous project at Worcester Polytechnic Institute called VeniceNoise. The main function of the VeniceNoise app is to collect sound clips throughout Venice in order to determine the noisiest parts of the city; therefore, its source code was helpful for us because it already had audio collection capabilities.

Figure 2: The home screen of the TewaTalk application

To make TewaTalk functional and useful immediately after implementation, we collected 549 initial recordings from Tewa speakers in the recording studio at the Indigenous Language Institute. We added these recordings to the TewaTalk database in order to load them onto the application so users would have access to at least one or two recordings for almost all of the script entries. These recordings were also added to our website and are available to download.

Figure 3: Photo of Virgie Bigbee recording in the ILI recording studio

In its current state, the website that corresponds to the TewaTalk application is in design form. We wanted to be able to display all of its planned components, so we created a Google Site. This method allowed us to have a mostly functioning design that could demonstrate how we want each feature to work and could also display the visual design of the site. Eventually, we would like an HTML-based website to be implemented based on this Google Site. There are eight main pages on the TewaTalk site. First, is a page that contains a QR code that allows

users to download TewaTalk. Next, is a page that contains the "Recording Dictionary" page that contains the entire categorized script. Entries that have available recordings have their own subpages where users can listen to or download said recordings. There is also a page where users can download the full Tewa dictionary written by Esther Martinez, a page for children that contains downloadable nursery rhyme songs, and two pages for flashcards and games. Finally, there is the website's homepage and an "about" page that contains information about the team and how we created the application.

Figure 4: Home screen of the TewaTalk website

While preserving the language by creating a database of words and phrases is important, truly preserving a language will not be successful unless we can attract new non-speakers to use our application in order to learn. In order to accomplish this, we have developed a number of interactive games that will allow users to learn the language in a fun and interesting environment. The first game uses listening comprehension to test users on their knowledge of Tewa. Players of this game will see a word written in Tewa and hear three different recordings; one correct and two incorrect.

Selecting the correct recording will add points to the users account and the players with the most points will be displayed on a leaderboard for all users to see. We have also designed a game to help bolster the database with new recordings, this scavenger-hunt type game will allow users to seek out new words and phrases that are not already part of the TewaTalk recording databases. Players of this game will gain points in a similar fashion to the "listening comprehension" game.

This leaderboard will hopefully create competition between players and in turn give them an incentive to learn. Eventually we hope that the game will be available on both the TewaTalk application and website so that everyone will have the chance to play and learn from our game. Opening up the games to more users will ensure that a wider audience uses them and eventually, more people will utilize them as a tool for learning their indigenous language

Figure 5: A mockup of the leaderboard as it appears on the Android application

When we were creating our application and our website, we needed to be careful to maintain a high level of privacy in order to prevent people not from the Pueblo of Pojoaque from accessing our material. Although the people of Pojoaque have been very willing to share their language with us while completing this project, they generally keep their language to themselves. As a result, our website is password protected so only authorized users may access its content including the page with the application's QR code.

The issue of privacy was not a difficult obstacle for our team to overcome with this project, but the need to keep the language a secret does pose a problem for overall preservation of the Tewa language. For example, there are as many different dialects of Tewa as there are Tewa-speaking Pueblos and these dialects have many similarities; however, most of the Pueblos strongly maintain distinct dialects. Encouraging use of Tewa across dialects could increase the number of people willing to replace English with Tewa in many social settings because there would be more people to communicate with. There could also be language classes open to all Tewa children at the Santa Fe Indian School. The Pueblos could pool their resources to create a successful Tewa curriculum, taught by a professional language teacher. Additionally, if privacy was not an object, we could have made TewaTalk available to anyone who wanted to learn the language.

Figure 6: The QR-Code for our application download

Because our app is restricted to members of the Pueblo of Pojoaque, we recommended a method for those who speak an indigenous language and are interested in preservation to create their own versions of TewaTalk. Right now, our source code is available and anyone with programming experience is welcome to take our source code and apply it to any language they wish. Most people, however, do not have a strong enough background in programing and computer science to have the necessary skills to create their own application. In order to allow everyone the opportunity, we designed a website that would generate personalized source code and a corresponding website. We created a mock-up of this website and named it, "iliTalk". In the preliminary design of the iliTalk website, users fill out a form with basic information and edit a version of our script to have source code for customized versions of the TewaTalk application and website instantly generated. Another method we thought of was to implement a computer science-based course at the Santa Fe Indian School where the students would learn how to recreate the TewaTalk app for their own cultures.

Even though the TewaTalk application and website are not fully complete, they have generated a very positive response from the community and have a lot of potential to be very

successful. We hope that this project will continue so TewaTalk can be fully implemented and potentially applied to other endangered indigenous languages.

Authorship

The members of this team provided equal contributions for the different sections of this report, and every student deserves an equal share of credit as authors. The following describes the contributions of each student during this Interactive Qualifying Project.

Virginia Bell contributed to the completion of the paper by writing sections of the methodology for the "Creation of the TewaTalk Website" and the "Recommendations" section

Matthew Fusco contributed by writing the "Background" section, the "Creation of the TewaTalk Application" section as well as the "Authorship Page" and the "Conclusions" section.

Karin Greene collaborated on the "Intro", as well as the "Creating the TewaTalk Website" section. She wrote sections of the "Conclusions" section and the "Executive Summary".

Andrew O'Neill focused on writing the "Abstract", sections of the "Background" and the methodology sections of the "Creating the TewaTalk Application" section.

Acknowledgements

There are several people who contributed to the overall success of our project. First of all, we would like to thank Ineé Slaughter for allowing us to use all of the Indigenous Language Institute's facilities and equipment, and for providing assistance with communication and necessary background information. We would also like to thank Felicia Rivera for being a liaison between the Pueblo of Pojoaque and us, for putting us into contact with Tewa speakers who could help us record, and for providing a venue for our final presentation.

The script we created for the application was edited and revised by the Tewa Language Committee, and we appreciate their efforts. Our recordings were created by Virgie Bigbee, Jeremy Montoya, Eva Mitchell, and John Garcia, and we are very grateful for their contributions.

We were able to gain more insight about the Pueblo of Pojoaque and feedback about our project from George Rivera, Joseph Talachy, Karl Duncan, and Sam Catanach when we went to visit the Pueblo. We would like to thank these people for taking the time to help us.

Finally, we would like to thank Anne Kandler from the Santa Fe Institute for allowing us to visit the Institute and for presenting her work regarding the decline of the Gaelic language to us, personally. Our visit to the Santa Fe Institute provided us with many ideas for our analysis and recommendations sections.

Table of Contents

List of Figures

List of Tables

1. Introduction

As global commerce and trade increases, national languages such as English, Spanish, and Mandarin have become dominant for trade, politics and entertainment in many countries. The governmental and societal push for universal languages is known as a "language shift," and causes countries to rely on universal languages for communication rather than local indigenous languages. It has been estimated that, of the world's 6,900 known languages, 60 to 90% of these languages will be extinct by the end of the century.[1] Of the remaining languages, 52% have fewer than 10,000 native speakers.[2] When a language is no longer needed for communication with the majority of the population, the language quickly falls into disuse and if this period of disuse extends for too long of a time, the number of native speakers starts to dwindle. If these languages are no longer transmitted to children by their elders, the next generation of speakers will not know the language well enough to teach it to the subsequent generation.[3] Without drastic intervention, this cycle will continue until all native speakers have passed away and the language becomes extinct, preserved solely through written texts and memories. In many indigenous cultures, children are learning the language that they are most exposed to outside of their home, whether through non-native neighbors, schools, or the entertainment industry.

North America is no exception to the language shift that is harmful to the number of speakers of indigenous languages. Early settlers of North America saw the native population as people to be conquered. Indigenous people were torn from their homelands by European conquest and were pushed into unfamiliar territories.[4] Governmental policy of the time sought to assimilate the Native Americans into the new "American culture" and punished those who spoke their indigenous language. As a result, of the remaining 154 languages indigenous to North America,

---

[1] Suzanne Romaine, "Preserving Endangered Languages," *Language and Linguistics Compass* 1, no. 1-2 (2007), January 23, 2012.
[2] Ibid.
[3] Ellen L. Lutz, "Saving America's Endangered Languages," Cultural Survival, http://www.culturalsurvival.org/publications/cultural-survival-quarterly/united-states/saving-americas-endangered-languages (accessed Jan 24, 2012).
[4] Ibid.

about 84 of these languages have declined to 100 speakers or fewer.[5] New Mexico is home to 19 different Pueblo tribes with 11 different indigenous languages between them.[6] One of these indigenous languages is Tewa. Even with six Tewa speaking Pueblos, including Nambe, Ohkay Owingeh, Pojoaque, San Ildefonso, Santa Clara, and Tesuque, the language has dwindled to less than 1,300 remaining speakers, an alarmingly low number for a tribe that once flourished, with nearly 6,000 speakers in 1630.[7] Many indigenous languages do not traditionally have written forms, making education and preservation of the language difficult for the tribes,[8] and because of these preservation difficulties, many linguists predict that by 2050, only 20 indigenous languages will remain in the United States.[9] While there have been small efforts to help restore these languages in the past, if something is not done, native languages like Tewa will soon become extinct, resulting in a loss of important American history, culture, and heritage.

Founded in 1992, the Indigenous Language Institute (ILI) has been working to help prevent the Tewa language from going extinct through the use of technology and spreading awareness of the dangers of language loss.[10] The ILI has sought to "provide vital language related services to Native communities so that their individual identities, traditional wisdom and values are passed on to future generations in their original languages."[11] The ILI provides tools and educational workshops to help local tribes create textbooks, teaching aids, films, digital stories, flyers, brochures, posters, toys, signage, and other materials that can be used by the locals to preserve their language and educate others.[12] Participants in their workshops are also taught to create recordings of the spoken language using state-of-the-art recording stations. These recordings are then paired with the written

---

[5] James Estes, "Indigenous Languages Spoken in the United States (by Language)," National Clearinghouse for Bilingual Education, http://www.yourdictionary.com/elr/natlang.html

[6] Laura Redish, "Native American Tribes of New Mexico," Native Languages of the Americas, http://www.native-languages.org/nmexico.htm (accessed Jan 28, 2012).

[7] "Tewa Pueblos- Settlements," http://www.everyculture.com/North-America/Tewa-Pueblos-Settlements.html

[8] Redish, *Native American Tribes of New Mexico*

[9] J. Crawford, *Bilingual Education: History, Politics, Theory and Practice*, 4th ed. (Los Angeles: Bilingual Educational Services, 1995).

[10] Ibid.

[11] Ibid.

[12] Ibid.

documents to create audiobooks that will be useful in teaching the sound and pronunciation of the language to the youth.[13]

The Indigenous Language Institute has made huge strides in the preservation of the Tewa language and revitalization of the language in the local culture. Their use of state-of-the-art technology provides Native Americans with invaluable learning materials for local schools and other institutions. Although the technology used by the ILI to record and chronicle the Tewa Language is state-of-the-art, there is a need to expand the use of technology tools to more people to better preservation efforts. In order to better preserve the language, a method of involving the local population is needed. With the rise of smart phones in America, more and more people have the ability to become mobile recording stations with the help of their phones. As an example of this, the VeniceNoise application is a project intended to record noise levels in Venice using a mobile application as the recorder and everyday people as the data collectors. This concept of an easy to use and effective recording application could be easily applied to the preservation of the Tewa language. Through the use of mobile technology, more people could assist in preserving the language and in turn provide educational materials for future generations.

[13] Ibid.

2. Background

In order to better understand the best methods of preserving and rejuvenating the Tewa language, it is first important to learn about languages in general. Studying the larger "global" languages and learning the factors that allow these languages to remain strong and relevant in today's society will provide a model for the components of language survival and continued prosperity. Researching threatened and endangered languages can provide us with important data on factors that lead to language decline. When focusing on the preservation of the Tewa language, it is important to know the history of Native American tribes. Knowing the economic, social, and governmental factors within the United States that contributed to a language decline will provide well-documented case studies and assist in defining the parameters of the decline in Tewa fluency.

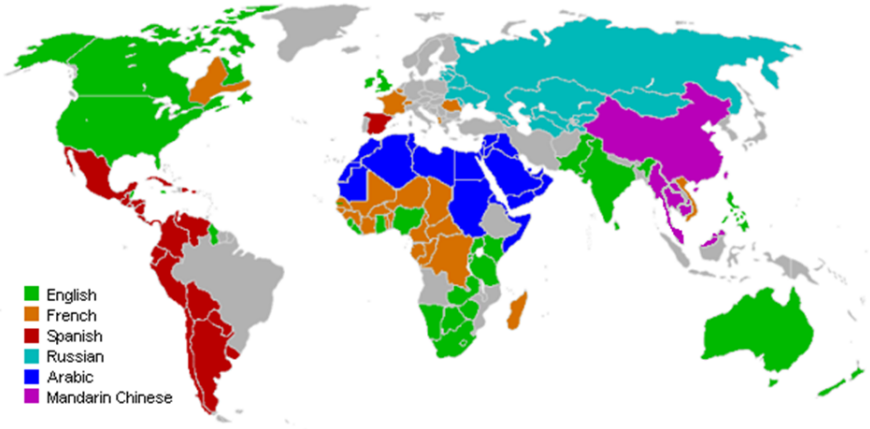


Figure 7: A map of the dominant languages worldwide[14]

Finally, looking at past preservation examples and techniques will provide us with specific examples of successful and failed language rejuvenation efforts to help us define methods and processes of the rejuvenation of the Tewa language.

---

[14] Rob Meyer, "**the 6 most Influential Languages in the World, and how to Learn them Online for Free**," http://gobudgettravel.com/wp-content/uploads/2007/07/languages21.png

2.1. Languages of the World

Worldwide, there are approximately 6,900 languages spoken regularly across 196 countries.[15] Of these languages, 75 of them are considered "large languages" with over 10 million speakers, such as English, Spanish, Mandarin and Arabic. The expanse of these large languages, allow for easier global trade, politics and transmission of ideas between nations.

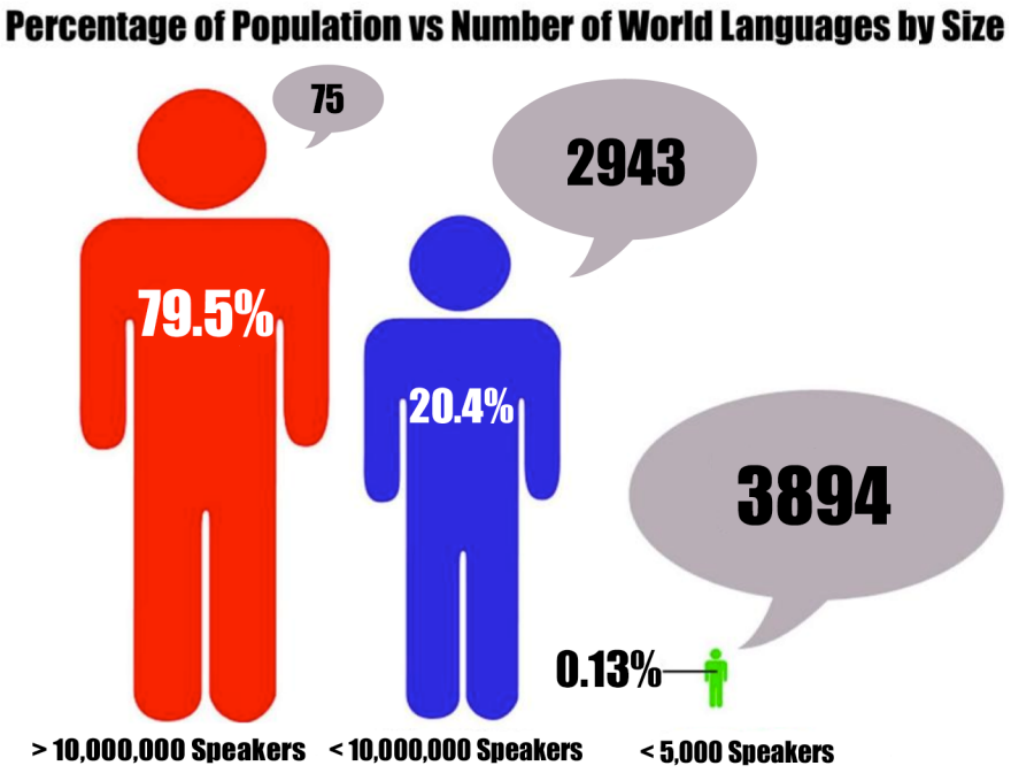


Figure 8: A graphic depicting the percent of the world's population and the number of languages they speak

Throughout the past few hundred years, many attempts have been made to create a unifying language, one language that would unite all the different languages of the world under a single tongue.[16] In the early 1900's a group of scholars developed Interlingua, a language which combined

[15] M. Paul Lewis, "Ethnologue: Languages of the World," SIL International, http://www.ethnologue.com/home.asp (accessed 16,

[16] Watsons Davis, "Practical World Language," *The Science News-Letter* 62, no. 1 (Jul. 5, 1952), pp. 10-11.

many of the words of different languages into one simplified language. Interlingua also sought to discard "troublesome intricacies of grammar" such as verb tenses and subject-verb agreement.[17] The motivation for creating a universal language is to create easier methods of trade and diplomacy between nations as well as establish a greater feeling of global community.

Because of the western world's influence on global politics, technology, and entertainment, English has become more commonly used in as a global means of communication. Many countries in Europe and Asia teach their children English as well as the national language of their country. With this increase in communicability, come some serious drawbacks. If one language prevails as the main language of the world, over time, the lesser spoken indigenous languages will become obsolete. If the human race were to lose the indigenous languages across the globe, a huge part of human history and culture would be lost.

2.2. Endangered Languages

As global languages prevail, smaller and less commonly used languages will suffer as a result. Many of the languages that are in danger of being lost are spoken by a relatively small demographic of people in a specific geographic area. Languages such as Welsh, Basque, and Native American languages of North America are in danger because established "global languages" are becoming more convenient in everyday life.[18]

This change from using indigenous dialects to speaking more globally relevant languages is known as "Language Shift" and can be brought on by a variety of means. Natural disasters, wars, and famines can wreak havoc across a region and effectively destroy a culture, and with them their indigenous language. However, these cataclysmic examples of language loss are not the main causes of language shift. Language shift is typically caused by the impact of one language or culture on another.[19]

---

[17] Ibid.
[18] Joshua A. Fishman, *Can Threatened Languages be Saved?: Reversing Language Shift, Revisited : A 21st Century Perspective*, Vol. 116 (Clevedon [England]: Multilingual Matters, 2001).
[19] Fishman , *Can Threatened Languages be Saved?: Reversing Language Shift, Revisited : A 21st Century Perspective*

English is the most prevalent language within the United States and therefore obscures the use of indigenous languages in social and political spheres. This trend is observed in American government, since English is used to draft laws and other judicial documents. Because of this, it is necessary for an indigenous speaker to learn English in order to participate. Globalization of pan-Western culture and Western pop-consumer culture is another major source of language shift.[21] The entertainment industry in America uses English to create and distribute various forms of entertainment such as books, magazines, television shows, movies, and music. If an indigenous speaker of a native language wants to enjoy the mainstream media, they first need to learn the predominant language of their nation. "American dominated globalization has become the major economic technological and cultural thrust of worldwide and Westernization… threatened languages must oppose the very strongest processes and powers that the world knows today." [22]

Figure 9: UNESCO's components of language vitality[20]

One organization working to reverse language shift is the United Nations Educational, Scientific and Cultural Organization (UNESCO). Established in 1945, UNESCO develops programs aimed at promoting languages as educational and cultural tools. With a strong focus on data collection, the organization created a set of universal standards for determining a language's vitality. By directly targeting components like "Availability of materials for language education and literacy"

[20] UNESCO Ad Hoc Expert Group on Endangered Languages, "Language Vitality and Endangerment," (2003).
[21] Ibid.
[22] Ibid.

and "Intergenerational language transmission," UNESCO works to reverse language shift for endangered languages worldwide.[23]

2.3. Native American Languages

The term Native Americans refers to any of the indigenous people in North America within the present day boundaries of the continental United States or Hawaii (the indigenous people from Alaska are known as "Alaska Natives").[24] At one time, hundreds of separate tribes spread across the continent, all with varying languages, traditions and customs. In the early years of westward expansion, the European colonists had an uneasy relationship with the native people. In 1763, a boundary was established west of the Appalachian Mountains to separate Native American country from that of the colonists. As the number of colonists grew, so did the need for land, therefore periodically moving the boundary westward toward the Mississippi River. Through the use of treaties, the inhabitants of these eastern lands were pushed westward as well.[25]

As the United States emerged as a sovereign nation, the fledgling Government sought to improve relations with the Native Americans in order to prevent them from allying with the British or French.[26] A factory system was established where tribes could trade furs for supplies at outposts scattered across the countryside. After the signing of the Rush-Bagot Treaty (1817), the demilitarization of the Great lakes lessened the threat of a British invasion and therefore the United States curbed trade relations with the Native Americans. The alliance with the Indians was no longer necessary for the survival of the new nation and so, the Native Americans were seen as a "worthless obstacle to 'manifest destiny.'" [27]

Since the presidency of Thomas Jefferson, it has been the policy of the United States government to allow Native American tribes to remain east of the Mississippi River so long as they accept the laws and regulations of American Government and assimilate themselves into American

---

[23] UNESCO Ad Hoc Expert Group on Endangered Languages, *Language Vitality and Endangerment*
[24] Fishman, *Can Threatened Languages be Saved?: Reversing Language Shift, Revisited : A 21st Century Perspective*
[25] Henry Eugene Fritz, *The Movement for Indian Assimilation, 1860-1890* (United States: , 1963).
[26] Ibid.
[27] Ibid.

society.[28] In a letter to William Henry Harrison, the Governor of the Indiana Territory in 1803, Jefferson laid out his plans on the assimilation of the Native Americans. He stated that it was the policy of the American Government to protect the Native Americans and to set up trading outposts for the sole benefit of the Natives.[29] These appropriations were motivated by the thought that the influx of American citizens would cause a decrease in game, rendering hunting insufficient for survival. This in turn would force the Native Americans to turn to more "American" ways of life, such as agriculture.[30] This practice sought the total reformation of the native cultures: Indigenous languages replaced by English, and cultural religion replaced by Christianity.[31]

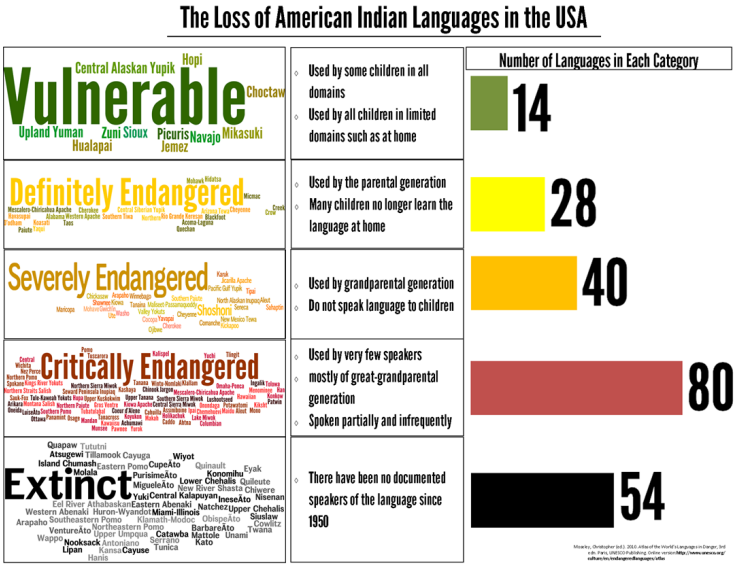


Figure 10: A word-graphic of the distribution of American Indian languages

Jefferson hoped that as the Native Americans turned to sedentary agriculture as a means of survival, they would "perceive how useless to them are their extensive forests, and [would] be willing

[28] Thomas Jefferson, Jefferson's Indian Policy, 1803.
[29] Ibid.
[30] Ibid.
[31] K. Tsianina Lomawaima and Teresa L. McCarty, "When Tribal Sovereignty Challenges Democracy: American Indian Education and the Democratic Ideal," *American Educational Research Journal* 39, no. 2, Education and Democracy (Summer, 2002), pp. 279-305.

to pare them off from time to time in exchange for necessaries for their farms and families." [32] The Native Americans would then hopefully allow American citizens into their lands and complete their own assimilation into the ideal American lifestyle. Those who resisted this assimilation, however, were shown the true power of the American government and were threatened with removal from their homeland.[33] Some tribes attempted assimilation willingly through the ratification of treaties with the United States. Other tribes resisted, and they were relocated by force.[34]

One of the most well-known relocations of Native Americans was the removal of the Cherokee, Chickasaw, Choctaw, Creek, and Seminole tribes; known as the "Five Civilized Tribes," they adopted of many colonial customs and maintained generally good relations with their neighbors.[35] Their removal, better known as the "Trail of Tears," demonstrated how the American government acted with complete disregard for the welfare of Native American tribes. The Five Civilized Tribes attempted assimilation, but the government was determined to obtain their land for westward expansion. The American government removed Native Americans from their land as a way to progress the fulfillment of Manifest Destiny.

Due to centuries of relocation and assimilation into American society, the number of indigenous people who still speak their native languages has dramatically decreased. Since 1950, 54 indigenous languages within the United States have gone extinct.[36] Today, there are less than 150 indigenous languages remaining within the United States, and an estimated 70 of these languages may not survive to the end of the decade.[37] The influx of western culture and the prevalence of English have reduced the need for native languages in many aspects of Native American life. As a result, many parents are no longer teaching their children the language of their tribes. If this process continues, an entire generation of potential speakers will not know enough of the language to pass it on to their children. This cycle will continue until the only speakers remaining are grandparents and

---

[32] Jefferson, *Jefferson's Indian Policy*
[33] Ibid.
[34] Charles J. Kappler, "TREATY WITH THE CHOCTAW, 1830," the Oklahoma State University Library, http://digital.library.okstate.edu/kappler/Vol2/treaties/cho0310.htm#mn1 (accessed February/21, 2012).
[35] Ibid.
[36] Lewis, *Ethnologue: Languages of the World*
[37] Romaine, *Preserving Endangered Languages*, January 23, 2012

great-grandparents to the current generation. This means that when the older generations die, the language will die with them.

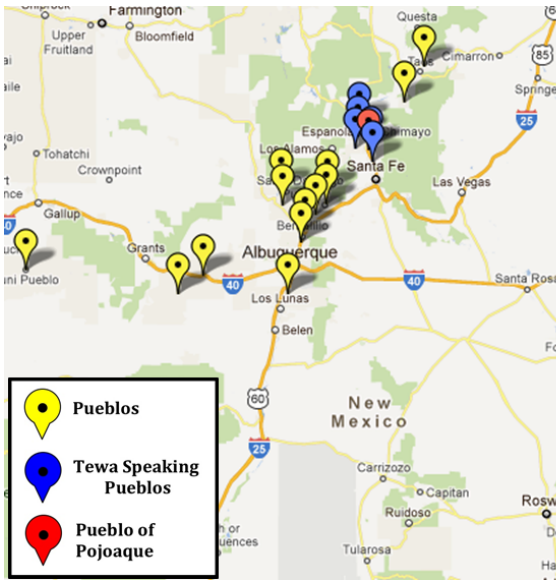


Figure 11: A map of New Mexico's Pueblo tribes.

2.4. Pueblo Languages

In the American Southwest, there are a group of twenty-one Native American tribes known as the Pueblos.[38] The Pueblo people can be broken into four linguistically diverse groups: Uto-Aztecan languages, Keresan languages, Kiowa-Tanoan languages and the Zuni language. The Uto-Aztecan languages, spoken by an estimated 5,260 people in the Hopi Pueblo, are a set of languages distantly related to Nahuatl, the language once spoken by the Aztecs. The Keresan languages are spoken by an estimated 8,000 speakers within seven Pueblo tribes in north-west New Mexico. The Kiowa-Tanoan language family is a set of languages spoken by twelve Pueblos in New Mexico and Texas, with an estimated 3,200 speakers.

2.5. The Tewa Language

Tewa is one the twelve indigenous languages in New Mexico. Spoken by six of the New Mexico Pueblo tribes, Tewa is an ancient language spoken by an estimated 1,300 people.[39] Tewa culture derives from the pre-Pueblo peoples and cultures known as Anasazi, whose origins are found in archaeological sites at Mesa Verde in southwestern Colorado and extend southward following the courses of the upper Rio Grande and Chama Rivers in New Mexico and the San Juan

[38] Redish, *Native American Tribes of New Mexico*
[39] Ibid.

River in Arizona.[40] The number of fluent Tewa speakers has been dwindling over time, and is considered to be a severely endangered language.[41]

The name Tewa is a derivation of "Teguas" the name that the Spanish conquistador Juan de Oñate assigned to the indigenous people he encountered in his 1598 exploration into territory north of Mexico.[42] Oñate set up his capital of New Mexico just outside the Tewa Pueblo of Ohkay Owingeh. From this proximity, he and the other Spanish colonists subjected the Tewa people to an extraordinarily harsh rule.[43] The Pueblo tribes were forced to sign a treaty which allowed Spanish authorities to occupy the Pueblos and claim them as part of the Spanish Empire. Pueblo tribes living under the rule of the Spanish authorities were prohibited from practicing their traditional religion, forced to pay tithes to the Spanish, and required to labor on the colonist's land estates.[44]

There are a number of reasons for the decline of the Tewa language in recent years. Since the acquisition of New Mexico in the mid-nineteenth century, the presence of American settlers created a society where learning English was more beneficial to tribes than it was in the past. Nearly all the Tewa speakers today are bilingual and use English for many social, economic, and governmental situations.[45] The constant use of English in everyday life has put less importance on speaking Tewa to communicate. As a result, many parents are not speaking the language in their home, preventing children from learning Tewa at a young age.

Tewa does not have a universally accepted written form, an issue in preserving the language. This lack of a written form reduces the ways in which the language can be taught, limiting the methods of teaching to lessons which can be listened to. Many Pueblo elders believe that the

---

[40] Sue-Ellen Jacobs, "Tewa Pueblos," in *Encyclopedia of World Cultures*, Vol. 1 (New York: Macmillan Reference USA, 1996), 347-350.
[41] Christopher Moseley, "UNESCO Atlas of the World Languages in Danger," UNESCO Publishing, http://www.unesco.org/culture/languages-atlas/index.php?hl=en&page=atlasmap (accessed March/1, 2012).
[42] Jacobs, *Tewa Pueblos*, 347-350
[43] Ibid.
[44] Leonie Sandercock, *Making the Invisible Visible: A Multicultural Planning History*, Vol. 2 (Berkeley: University of California Press, 1998).
[45] John Peabody Harrington, *A Brief Description of the Tewa Language* (United States: , 1910).

language should be preserved without a written form, but others believe that a written form increases accessibility to children learning the language.

In recent years, the Indigenous Language Institute has been working to help preserve languages like Tewa by working closely with the tribes to create educational programs and increase interest in the languages.[46]

2.6. Language Preservation

Protecting endangered languages is essential to preserving many aspects of world culture, without which a great deal of historical significance would be lost. An indigenous language is a direct index of the culture that speaks it, and can give scholars a good approximation of the daily lives of the people who first spoke the language. For example, the Eskimo language has several words describing various types of snow. Because of their constant exposure to snow, it was important for them to distinguish between the types. In many cultures who spoke Benuin Arabic, horses were an integral component of trade and transportation. This is seen by their multitude of words describing different physical features of horses.[47] In the Tewa language, where family relationships and procedure are of the utmost importance, there are words which describe familial relationships that do not have a direct translation into other more global languages.[48] These differences in languages can be used to learn more about the people and their values. For these reasons, a global language such as English is not a proper replacement for indigenous languages. If a culture wants to retain its heritage and history, preserving the spoken language is one of the most important things that can be done.(Jacobs 1996, 347-350)

---

[46] Jacobs, *Tewa Pueblos*, 347-350
[47] Gina Cantoni-Harvey, *Stabilizing Indigenous Languages*, 1996).
[48] Edward Dozier, "Kinship and Linguistic Change among the Arizona Tewa," *International Journal of American Linguistics* 21, no. 1 (1955), 242.

2.6.1. Examples of Successful Language Revivals

Many linguists have taken it upon themselves to rejuvenate endangered languages across the globe. Preservation efforts have used a variety of techniques, such as governmental, educational and technological methods to help counter the effects of language shift.

Figure 12: Image of the written Hebrew language

The revitalization of the Hebrew language is often associated through the actions of one man. Although Hebrew was not spoken conversationally for about 1,700 years, Eliezer Ben-Yehuda and his wife, Deborah, aspired to make it their own native language and teach it to their children after their move to Palestine in 1881.

According to Gabriel Birnbaum of Israel's official Academy of the Hebrew Language, Ben-Yehuda believed that "Hebrew must be the language of the nation and that if Hebrew were revived, the nation would be revived." [49] Ben-Yehuda generated three plans of action: speaking Hebrew in the home, teaching it in schools, and conversing in Hebrew with other Jewish people.

Even before arriving in Palestine, Ben-Yehuda decided to only speak Hebrew with every Jew he encountered and wanted it to be his only language at his arrival. When Ben-Yehuda's first son was born in 1882, Deborah promised to raise him as the first all-Hebrew speaking child in modern history. In this way, Ben-Zion's parents and visitors would need to converse on everyday topics with him in Hebrew.

Ben-Yehuda recognized that teaching the language in the schools was important because the children will be become unilingual in Hebrew when they grow up. Teaching Hebrew in schools was

[49] Marjorie Miller, "Revival of Hebrew Set Linguistic Precedent," *Los Angeles Times*, sec. Observer, 1998.

a difficult task due to the lack of trained teachers, materials, and terminologies. Through the help of his wife and son, Ben-Yehuda compiled a precise and accurate Hebrew dictionary to be used as a teaching material in Jewish schools.

The Hebrew language was not brought back solely on the actions of Ben-Yehuda, but he inspired others to begin speaking it conversationally. The truth is that over 50% of all male Jews were able to understand the Pentateuch and the daily prayers, and about 20% could read a difficult Hebrew book. Jews were able to speak Hebrew, but through the efforts of Eliezer Ben-Yehuda, it became the language of their daily lives.[50]

Currently, Hebrew is the official language of Israel with a Jewish population of 76.4%.[51] The number of total native speakers across the world is approximately 5.3 million, and is still increasing. Hebrew is in the top 125 most spoken languages in the world, comparable to languages such as Danish and Finnish.[52]

2.6.2. Efforts Made to Preserve Native American Languages

Jessie "Little Doe" Baird is a linguist working to restore her Native American community. The Wampanoag language had tens of thousands of speakers before European settlers arrived. Through a mixture of force and assimilation, the Wampanoag language gradually declined over the centuries. Baird founded the Wôpanâak Language Reclamation Project in an attempt to reclaim the Wampanoag language. Using her knowledge of linguistics and language pedagogy at Massachusetts Institute of Technology, she began to decipher grammatical patterns and compile

Figure 13: Linguist Jessie "Little Doe" Baird

[50] Jack Fellman, "Eliezer Ben-Yehuda and the Revival of Hebrew," http://www.jewishvirtuallibrary.org/jsource/biography/ben_yehuda.html
[51] Central Intelligence Agency, "Israel," The World Factbook, https://www.cia.gov/library/publications/the-world-factbook/geos/is.html
[52] Lewis, *Ethnologue: Languages of the World*

vocabulary lists from preserved documents.[53](Anonymous2010) Through research and years of work, Baird succeeded in creating a 10,000-word Wampanoag -English dictionary. As a fluent speaker, she continues to help students, historians, and linguists wishing to learn more about the language. Baird created teaching materials ranging from after-school classes for children to advanced courses for adults.[54]

Esther Martinez, like Baird, wanted to preserve her own Tewa language. She grew up in San Juan Pueblo (Ohkay Owingeh) and attended the Santa Fe Indian School. In the 1920's, Martinez lived at a government-run boarding school for Native Americans where she was prohibited from speaking or listening to Tewa. The school aimed to incorporate the Native Americans into the American culture, forcing them to leave their stories and language behind.

Figure 14: Tewa linguist Esther Martinez

Martinez retained her knowledge of the Tewa language and in her adult life became a teacher of Tewa. She compiled a dictionary, and an interactive Computer program aimed at educating

[53] "Jessie Little Doe Baird,"
http://www.macfound.org/site/c.lkLXJ8MQKrH/b.6241221/k.5A66/Jessie_Little_Doe_Baird.htm
[54] Ibid.

children. She also helped to lay the foundation for what would become the Indigenous Language Institute.[55]

2.6.3. Preserving Language through Education

When Native American communities attempt to teach their language, many of the men and women chosen to teach are fluent speakers, but have no experience in teaching children. They have no classroom management skills, teaching methods, or appropriate practices for properly instructing the students. Fluent speakers of dying languages in many cases are older men and women who are disconnected from technology that many students are using to learn.[56] These elder teachers are rooted in tradition and whether from respect of this tradition or from other socioeconomic troubles, cannot afford to relearn their practices of teaching.[57]

In order for a dying language to be retaught to the youth, a more developed and advanced method must be upheld. Professionally trained language teachers are a necessity to educating children, but what is even more important is returning to the "mother tongue" method of language transmission. "Mother tongue" refers to the practice of learning a language from infancy by hearing it spoken in the household. If a child is reared in an indigenous language speaking household, that child is much more likely to be a speaker of the language.[58]

The prevalence of English in Native American communities makes the "mother tongue" approach difficult in many families. English is used in most legal documents, educational materials and entertainment mediums. Because of this predominance, Native American families are more prone to speak English around the household, neglecting the fact that their children will not be absorbing the language at a young age.[59]

---

[55] Jocelyn Y. Stewart, "Esther Martinez, 94; Tewa Speaker Worked to Save Her Language," *Los Angeles Times*, sec. Obituaries, 2004.
[56] Cantoni-Harvey, *Stabilizing Indigenous Languages*
[57] Ibid.
[58] Ibid.
[59] Ibid.

2.7. The Use of Modern Technology in Language Learning

In order to better preserve Native American languages, many companies and organizations worldwide are turning to technological means. Organizations such as Rosetta Stone through their "Endangered Language Program," allow Native American tribes to work with Rosetta Stone's language experts to translate, adapt, and customize a personalized edition of the popular Rosetta Stone software. The software can then be integrated into the school language program, or for personal home use. So far, indigenous languages such as Mohawk, Navajo, and Chitimacha have used the Rosetta Stone program to create their own software with very positive results.[60]

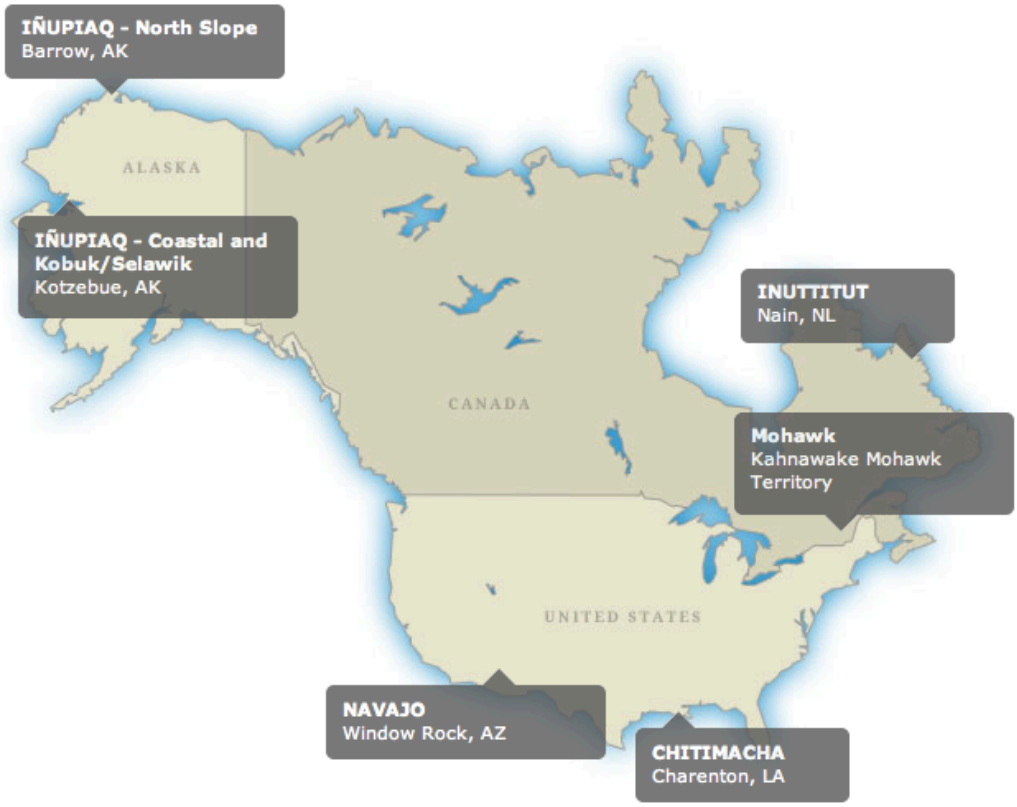


Figure 15: Location of Rosetta Stone's Endangered Langauge Programs

[60] "Endangered Language Program: We Preserve More than Words," Rosetta Stone, http://www.rosettastone.com/global/endangered

Technological advances such as modern computers have taken a large role in the preservation of languages and the reeducation of the Native American youth. Recording the language can preserve much more than merely writing down the words is able to do. Recordings preserve grammar, phonology, rhythm, beat, prosody, and various dialects of the language. By simply reading a text version, the full spectrum of the language would be diminished.[61] Recordings are the best method of preservation so far, but even they have drawbacks. As technology increases, many older technologies fall into disuse and obscurity. Language recordings made twenty years ago on a certain recording device will not be compatible with a modern computer. People who record modern languages should be aware that the method of playing back their recordings may not be available in the future.

Without an educational motive behind the preservation of the language, the recorded language becomes nothing more than a mausoleum of words.[62] It is for this reason that planning and executing an educational program along with the preservation of the language is monumentally important to the preservation of any language. An example of this would be a computer program that combines recordings with a teacher approved lesson plan. This type of program could be used to document the spoken language and use the recordings to teach others.

In order to rejuvenate a dying language, the "mother tongue" approach is far past usefulness. The next generation of Native Americans in their late teens and early twenties are long past the age where simply hearing the language is useful in language learning.[63] What these people need is a method of teaching the language in a way that they are comfortable with. Using digitized recordings and implementing them into an educational system, Native Americans will learn conversational speaking. If this educational program is successful enough, the educated students will hopefully become fluent in their language, and when they have children of their own, instill their knowledge of the language through the "mother tongue" method of teaching.[64] This process will hopefully

---

[61] Cantoni-Harvey, *Stabilizing Indigenous Languages*
[62] Ibid.
[63] Joshua A. Fishman, *Reversing Language Shift* (Bristol, PA USA: Multilingual Matters Ltd, 1991).
[64] Ibid.

continue until all indigenous children will learn the language at a young age and in turn, use it in their daily lives.

2.7.1. SuperMemo

One example of technology aiding in language education is SuperMemo. SuperMemo is software that anyone can download on Windows, Pocket PC, Palm Pilot, or on-line that increases the speed of learning with a high level of retention.[65] This technology was developed in Poland from 1982 to 2000, and it accelerates learning by optimizing the timing of review by computing optimum intervals between repetitions. This is based on the concept that after learning a fact, you need to refresh this fact before you forget it. This technology calculates the average time it takes for a person to forget a fact over time. SuperMemo will remind the user of the fact after a specified time of reviewing it. This software can be applied with learning a language. If new words are learned using this method, they have a higher chance of being stored into long-term memories.

2.7.2. Thornton Media Cherokee Basic

A form of mobile technology that is currently used for preservation of indigenous language is the "Cherokee Basic" application from Thornton Media. This app has eighteen categories of words of phrases along with two "sounds and syllabary" sections. Users can select a category to view all of its words and phrases. They can then select any specific entry to hear it spoken aloud in Cherokee. Most entries also are written in Cherokee characters and have a phonetic description beneath their English description. This helps to ensure that users are hearing sound clips correctly and it aids in the association of the Cherokee characters with their individual sounds.

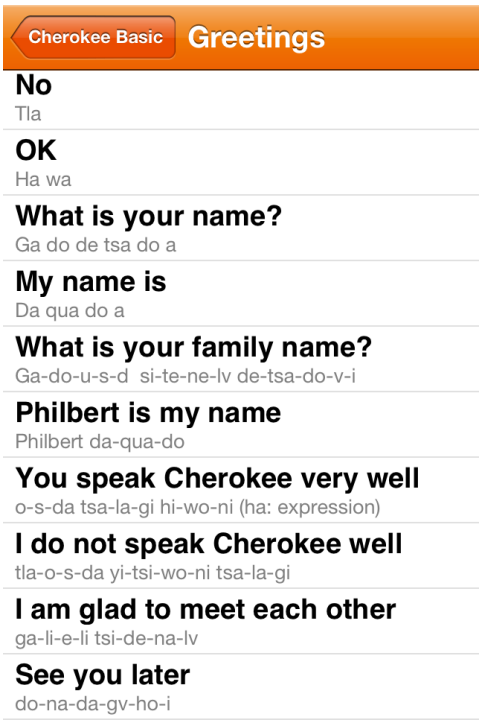


Figure 16: Cherokee phrases under the "Greetings" category

[65] Krzysztof Biedalak and Piotr Wozniak, "Super Memory: Forget about Forgetting," http://www.supermemo.com/index.htm

The two "sounds and syllabary" sections of Cherokee Basic contain tools for learning how to read and pronounce each Cherokee character. The first, "Sounds and Syllabary" contains different "rows" or categories of similar-sounding characters. Within each row is a list of the phonetic descriptions of each character and the option to play the pronunciation aloud. In the "Syllabary Chart" section, there is a table with each "row" on the left and vowels along with the letter "v" on the top. As seen in Figure 17, each character, from left to right across the table, represents a row paired with each vowel and the letter "v". This table provides an easily accessible reference for learning how to pronounce commonly used Cherokee characters.[66]

Figure 17: Cherokee Basic "Syllabary Chart"

Cherokee Basic is a valuable tool for anyone who wants to learn the basics of the Cherokee language or is looking for an interactive phrasebook. Because it is accessible to anyone with an iPhone, it is helpful for the preservation of the language. Members of Cherokee tribes who have left home can use the app to practice their native language and non-Cherokee people also have the ability to learn the language.

[66] "Langauge Tools for Indian Country," Thronton Media Inc., http://www.ndnlanguage.com/ (accessed May/5, 2012).

2.7.3. Android

Android is the most popular operating system amongst all of the smartphones. Comprising 48.8% of the market, it also has the highest annual growth in 2011 with 244%. The number of subscriptions in the Americas has increased from about 50 million in 2007 to nearly 300 million in 2011.[67] These facts make it a great technological tool, especially with the youth. A study in March

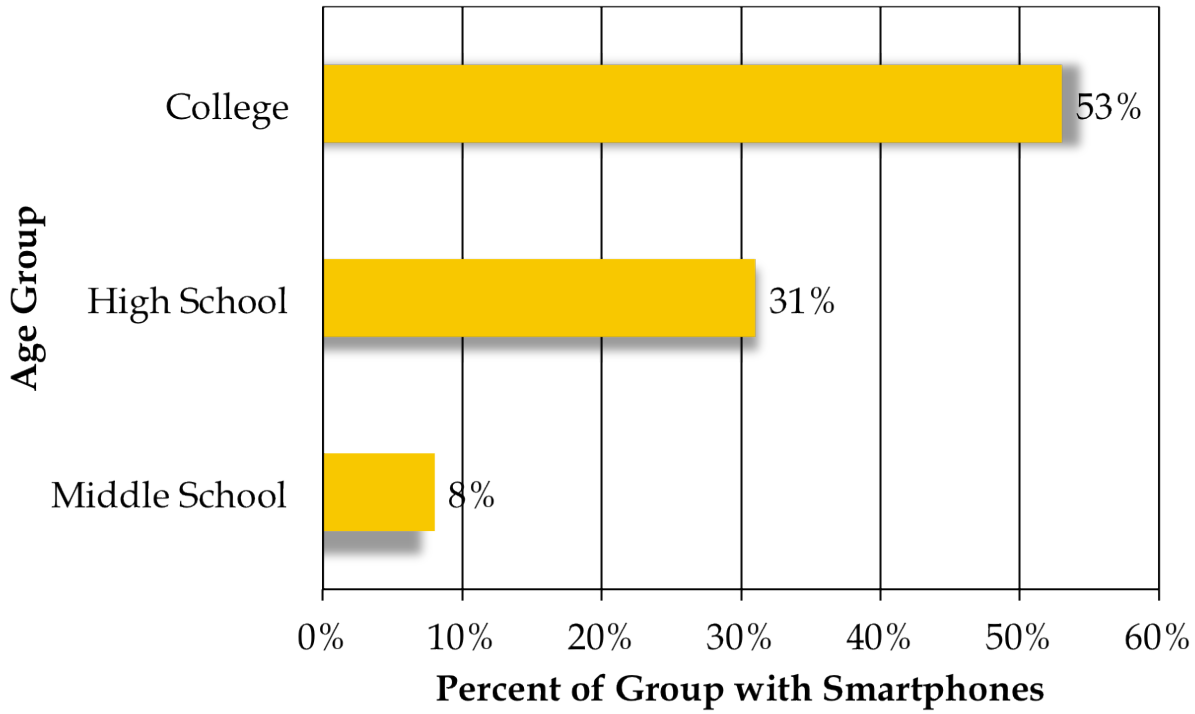


Figure 18: Chart of percentage of youth with smartphones in the United States

2012 showed that 8% of middle school children have smartphones. Similarly, 31% of high school students and 53% of college students have smartphones.[68] With the increase in users each year, it's expected that the youth will also have more smartphones, making it a prime learning tool since they

[67] Chilton Tippon, "PEW: Teens, Smartphones, & Texting Statistics," Talk Path LLC, http://all.pro/blog/pew-teens-smartphones-texting-statistics-188 (accessed 05/04, 2012).
[68] Ibid.

are more connected with their phone. The Android marketplace allows anyone to download applications ranging from games, to social networks, to the news. Especially when someone is learning a language, applications are convenient for learn phrases on-the-go.

3. The TewaTalk Application

The TewaTalk application was created to aid in the preservation and rejuvenation of the Tewa language. In the process of creating our finalized application, we worked closely with the Pueblo of Pojoaque and their Tewa Language Committee. Asking for their input on most decisions allowed us to build TewaTalk around their exact needs. Their willingness to work with us and their enthusiasm with our project enabled us to create the best possible TewaTalk application. We hope that our final product met their visions and expectations and aided in reversing the decline of the Tewa language by creating passionate learners and fluent speakers.

3.1. Designing the Application

Before the group began mocking up and coding the application, we found it necessary to discard any preconceived notions and build from the ground up. We needed to decide what exactly our completed application would do. Once we decided this, we broke the application design into three distinct sections: design constraints, design specifications, and application functionalities. Taking these steps allowed the group to explore all possibilities and design a strong final product.

3.1.1. Defining the Application Constraints

The first step of our design process was to determine what kinds of design constraints we would be dealing with in the project. Realizing our boundaries helped keep goals realistic and created the framework for the rest of the application. We broke our constraints into three sections: spatial constraints, time constraints and conceptual constraints.

Determining our spatial and time constraints was pretty straightforward. We knew that we would have seven weeks to plan and create our proposal, followed by seven weeks in Santa Fe, New Mexico to finish the project. Another very important type of constraint we faced was our monetary restrictions. During this project, IQP groups were expected to budget themselves, and must be prepared to pay any project expenses out of pocket. This limited some of the possible resources (programs, tools, hardware, etc,) due to budgetary constraints.

Another constraint that we faced was that our application was limited to the Android operating system. Having a mobile application is useful to the "on-the-go society" that we live in, and with mobile contracts increasing with each year, the application will be available to the increasing number of owners. We chose specifically to use the Android phone because it is the

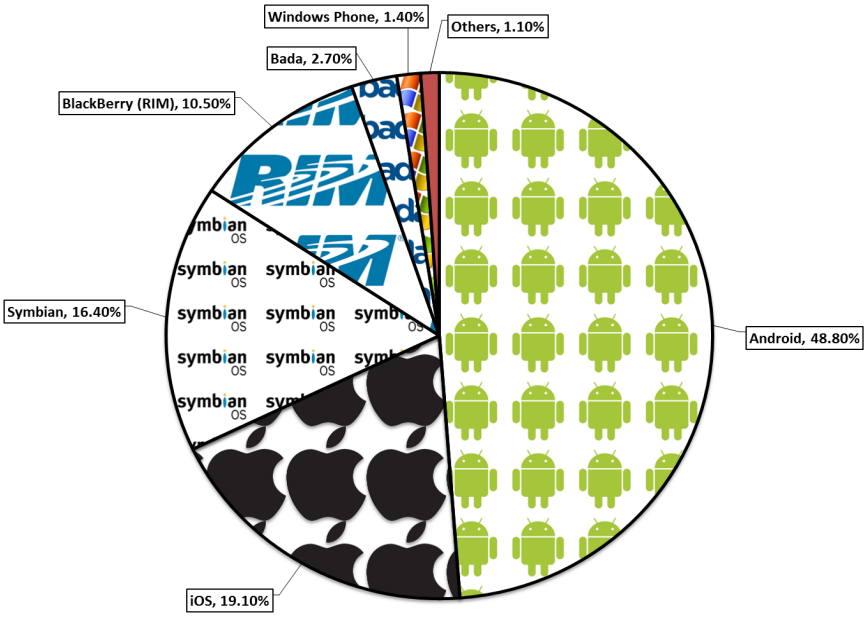


Figure 19: A pie chart demonstrating the global market share of smartphone operating systems[69]

most used phone across the world, comprising 49% of the total smartphone market. Additionally, we wanted to use the free source code from another Worcester Polytechnic Institute Interactive Qualifying Project, called VeniceNoise (see section 3.3.1). The application from this project was written for Android, and using it to build our application allowed us to spend more time creating useful features for language recording.

A final design constraint we faced was programming language. In deciding on the Android operating system, we constrained our application to use the Java programming language. Java for

[69] "Key Global Telecom Indicators for the World Telecommunication Service Sector ," INTERNATIONAL TELECOMMUNICATION UNION, http://www.itu.int/ITU-D/ict/statistics/at_glance/KeyTelecom.html (accessed February/29, 2012).

Android requires special development tools, so we researched the Android SDK (Source Development Kit) and how Android applications worked.

3.1.2. Defining the Application Specifications

The group created a set of design specifications by building off of our constraints. Constraints serve to tell us what we are limited to, while specifications are meant to give us a more detailed look into what we can do. How can the application store information? What kind of maintenance will the app require? Which Android OS should we design for? Questions like these needed answering in order to continue progress.

One of the best ways to come up with these specifications was to simply ask questions. Our group members would frequently have detailed discussions trying to conceive and answer these kinds of questions. Often times, when a question was answered, additional questions would emerge. We tried to focus on the needs of our users and sponsors to create an extensive set of strong specifications.

Some of the basic specifications of our application were the ability to:

1. Work on all versions of the Android operating system (Froyo, Gingerbread, Ice Cream Sandwich etc.)
2. Record the speech in the absence of cell coverage
3. Be easily navigated and utilized by all ages

Creating an application that followed these specifications allowed the application to be used by the greatest amount of people.

3.1.3. Defining the Application Functionalities

The final stage in our design process was defining the application's functionalities. Building off of our constraints and specifications, we began to elaborate on each specification into a more detailed functionality. Our specifications served to tell us what the app can do, while the functionalities tell us exactly how the application will do it.

There were a number of techniques used by the group to determine the application functionalities. We found that brainstorming sessions were an effective method. Additionally, creating simple mock-ups allowed us to visualize the application in various ways. Again, the group

had a very strong focus on the needs of the user, and focused on creating a fluid and natural user experience.

When designing any product, taking advantage of user feedback is a necessity. We asked our sponsors, Ineé Slaughter and Felicia Rivera, exactly what kinds of features they envisioned in the completed application. Between the group members, the Tewa Language Committee, and our sponsors, we agreed on the following key features.

Firstly, the application is able to record and play spoken words and phrases. This feature is the core component of the app, and allows the user to record and playback any recordings available to him or her. Secondly, the app should be able to seamlessly store and retrieve recordings with an online database. This allows the safe storage of the recordings. Thirdly, the application should be able to search through the database and easily retrieve recordings for the user. We continued to refine these features, as well as developed additional ones. Getting input from users was one of the easiest and strongest ways to figure out what the application needed.

3.1.4. Designing the Layout of the Application

Once the core features of the application had been realized, we began designing the layout. The easiest way to accomplish this was to sketch out the basic layout including as many details as possible. This allowed the group to visualize the application's basic functionalities and see the product through the user's eyes. We also asked for insight from the Pueblo of Pojoaque, our target demographic of users. Every mockup we made was first run by them for approval and critiquing. With their help, we designed an application which contains everything they need, many of the things they want and nothing that was extraneous.

We used PowerPoint to create interactive mockups . This method of creating mockups allowed for our audience to better understand how the application works because they were able to watch the manner in which the application would function when actually used by a user. In our mockups, we mapped out the entire application with graphics. (A full collection of all the mockups we made can be found in Appendix C)

After extensive planning and collaboration with the Pojoaque Pueblo, our final mockup of the application's main menu consisted of six icons:

1. Search
2. Browse
3. Submit Recording
4. Favorites
5. A flashcard learning tool
6. A game section

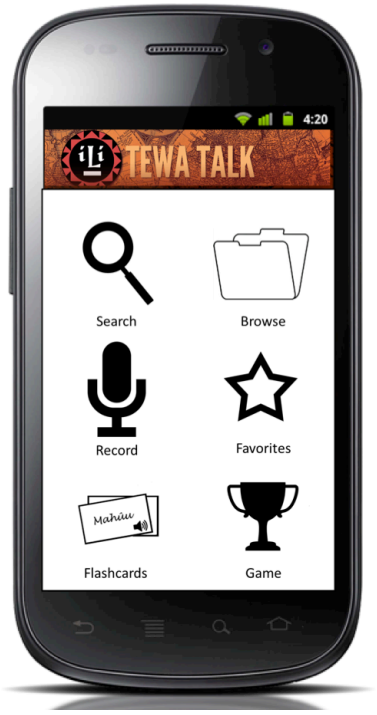


Figure 20: Mockup of the TewaTalk home screen

The "Search" button allows users to search for a specific word or phrase in the dictionary using Google search. If a phrase or word cannot be found, the user is given the option to record the phrase himself or request for that phrase to be added to a list of recordings that need to be added.

The "Browse" button brings the user to a screen displaying different categories of words and phrases that would be useful in certain situations. When a category is chosen, it brings the user to a page displaying a list of recordings that fall under that specific recording. Selecting a specific recording will allow users to play and listen to the recording, download the recording to their phone to a favorites list and display an information screen about the phrase including:

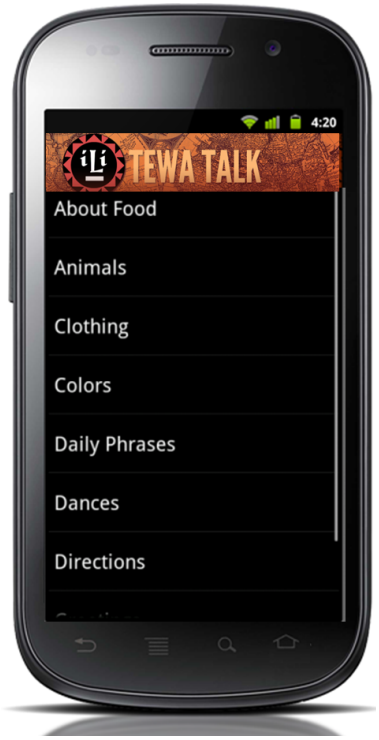


Figure 21: Mockup of the "Browse Recordings" menu

1. The English translation
2. The Tewa spelling
3. The category of the word/phrase
4. The dialect the phrase was spoken in, and
5. The gender of the speaker

The "Record" button takes the user to a screen with a where they are able to record a phrase using their phone, listen to it and check for quality and then submit the recording. Hitting

next prompts another screen which asks the user to fill out some information about the phrase including:

1. The English translation
2. The Tewa spelling
3. The category of the word/phrase
4. The dialect the phrase was spoken in, and
5. The gender of the speaker

If the user currently has a data connection (3G, 4G, Wi-Fi) selecting submit will add the created recording to the database. If the user does not currently have a data connection, the submission will be added to a queuing system that will automatically upload the sound file as soon as the user regains a data connection.

The favorites menu displays all the sound clips that the user has downloaded from the database to their phone. This allows users to listen to their favorite recordings without needing to stream the recording through a data connection. With this feature, users have the ability to use TewaTalk everywhere without the constraints of a steady data connection.

The flashcard learning tool is a helpful way for users to test their knowledge of the Tewa language. A flashcard consists of a word written in Tewa accompanied by a voice recording of that word. The user can guess what the word means, and on the flip side of the card is the translation in English.

The game menu has two different games available. Competing in these games gives the user points which are displayed on a leaderboard. The first game is a word recognition game which tests the user's knowledge of the Tewa language. Getting these questions correct will add points to your score and increase your position on the leaderboard. The second game is a scavenger hunt type game. Players of this game will gain points by adding new words and phrases to the database. Phrases that are deemed difficult to record will add more points to the total score than recordings known to be easy to find.

Although seemingly arbitrary, the points system will aid in the preservation and rejuvenation of the language. If given an incentive to learn or help, users will be more inclined to use our games. If the users are playing to gain points, they will unknowingly be learning the language through the word recognition game and aiding in the preserving of the language through the use of the scavenger hunt game.

3.1.5. Keeping the Application Private

One of the main concerns of the Tewa Langauge Committee in the creation of TewaTalk was keeping the recordings created by TewaTalk private. The Pueblo of Pojoaque does not want the application to be publically available. Instead, they want the application to only be accessible by those who are members of the six Tewa speaking Pueblos (Pojoaque, San Ildefonso, Nambe, Ohkay Owingeh, Santa Clara and Tesuque). These privacy concerns are typical of most of the New Mexico Pueblos and we took great care to honor these concerns.

Because of these concerns we did not submit the completed TewaTalk application to the Android Market. If TewaTalk was available on the Android Market, it would be accessible to everyone, there would be no way for us to control who was using the application.

3.2. Creating Recordings

When TewaTalk was released, we wanted people to immediately download the application and start listening to recordings and learning from them. In order to accomplish this, we needed our application to be fully functional from a "cold-start" with recordings of the Tewa language that we collected ourselves.

3.2.1. Writing a Script

Most people do not know which words and phrases are important to preserving a language. If we were to give users a blank database and ask them to fill it with random words and phrases, the result would be a disorganized mess. To ensure that TewaTalk would be an effective learning tool, it was first necessary to create an orderly system of organizing and displaying words and phrases which are proven to be useful to learning a language.

To accomplish this, we looked to other successful applications that worked with language education. The application created by Thornton Media called "Cherokee Basic" proved to be the most helpful to our project. "Cherokee Basic" was created by a group of Cherokee tribal members in order to help people learn the Cherokee language. It did this by creating a list of everyday phrases and words and then separating these phrases into simple and easy to navigate categories.

In the creation of the Tewa script, we emulated the "Cherokee Basic" applications category design and copied their script of words and phrases. We worked closely with the Pojoaque Language Committee to alter and rewrite this script so that it was specifically tailored to the Tewa Language.

For example, words such as "powwow" and "alligator" were removed because, although they had meaning in Cherokee history and culture, there were neither powwows in Tewa tribal ceremonies nor alligators in the Tewa geographical location. The finalized script was a combination of phrases which when studied, would provide users with an understanding of the Tewa language structure as well as a way to preserve words and phrases with historical and cultural significance to Tewa communities.

3.2.2. Recording Native Speakers

Using the script of words and phrases we created, we sat down with native Tewa speakers in the recording studio located at the Indigenous Language Institute. At the time of making these recordings, the application was not in a functional stage which would allow us to use it to make recordings. Using their state-of-the-art recording studio allowed us to make high-quality recordings without the use of the functional application. The native speakers were asked to speak as many words and phrases that they knew from the script we created. The phrases were then edited using Audacity and cut into compressed "mp3" sound clips which could be easily uploaded and played by a smartphone.

Figure 22: Virgee Bigbee, a native Tewa Speaker, in the ILI recording studio

3.3. Prototyping the Application

Once we had fully designed the application and collected initial language recordings, we could start creating the application. Using our mock-ups as a guide we started to program the application based upon the exact specification laid out to us by our sponsor and the Tewa Language Committee.

3.3.1. Using Venice Noise Source Code

In the creation of TewaTalk, we used the VeniceNoise application as a figurative "backbone," building off of it and tweaking it to our needs until our application was complete. There were many advantages to using VeniceNoise in this manner rather than starting from scratch.

For example, Venice Noise had already been made for Android which meant that it was already in the correct programming language of our intended final product. Another benefit was that the source code for VeniceNoise was free and easily accessible online. There were also voice recording capabilities already enabled in the source code of VeniceNoise. Lastly, VeniceNoise was tailored to work with a MySQL database. We planned to use a MySQL database to store and display our recordings, so the fact that VeniceNoise had the coding to do this was a real benefit.

Because none of us were well versed in Android Java, another advantage was that we were able to read the VeniceNoise code and learn from the code. By looking at the VeniceNoise code, we learned syntax, operations and methods of programming which are essential to the creation of a full functioning application.

3.3.2. Tools

After choosing VeniceNoise to stand as the foundation of our application, we started to alter and rewrite the code to our own specifications. Through extended periods of coding and testing, we slowly changed the VeniceNoise application to the functioning TewaTalk application. In order to do this, we used a variety of computer programs, software, and tools.

3.3.2.1. Android SDK/Eclipse

By using Eclipse, a multiplatform software environment, along with the Android Software Development Kit (SDK) we hosted the VeniceNoise code and emulated the application on an Android emulator. Through the alteration of this code, we slowly started to create TewaTalk. We had to add many features that were not present on VeniceNoise. Unlike VeniceNoise, TewaTalk required the ability to display and stream the recordings that were stored on a database as well as collect sound recordings. In order to apply this feature, it was necessary to develop a method of clearly displaying the MySQL database in a manner that was aesthetically pleasing and informative.

3.3.2.2. MySQL

MySQL was used as the repository for all the collected recordings. We hosted a MySQL database online on a private server. We created a table called recordings in that database, which contained columns for all relevant data (see Figure 23). Submitting a recording using the "Record"

```
Database changed
mysql> DESC recordings;
+-----------------------+-------------+------+-----+---------+----------------+
| Field                 | Type        | Null | Key | Default | Extra          |
+-----------------------+-------------+------+-----+---------+----------------+
| phrase_category       | text        | NO   |     | NULL    |                |
| recording_name        | text        | NO   |     | NULL    |                |
| recording_translation | text        | YES  |     | NULL    |                |
| recording_id          | int(8)      | NO   | PRI | NULL    | auto_increment |
| sound_data            | text        | NO   |     | NULL    |                |
| recording_gender      | int(8)      | YES  |     | NULL    |                |
| recording_notes       | text        | YES  |     | NULL    |                |
| recording_dialect     | varchar(60) | YES  |     | NULL    |                |
+-----------------------+-------------+------+-----+---------+----------------+
```

Figure 23: Terminal display of the MySQL table

function of the application would send a sound clip in .WAV format along with all other data on the recording supplied by the user, which would then be uploaded through the phones data or Wi-Fi connection. A PHP script within the database would then format the submission into a configuration that was readable by the MySQL database. This submission was then added to the database and made available for the "Browse" function of the phone to locate and stream the uploaded recording as well as display all the submitted information.

3.3.2.3. Adobe Photoshop

We used Adobe Photoshop to create images, icons, and banners for our application. These were then imported into the TewaTalk code by saving them as .PNG files and using Eclipse and the Android SDK to display and position the banners and icons within the application.

Figure 24: The TewaTalk banner created using Adobe Photoshop

3.4. Establishing a Filtering Method

The goal of our project was to not only create an application, but a successful educational tool. In order to do this, we needed to ensure that our recordings were of the highest quality and accuracy. One of our concerns was that users would submit inaccurate or irrelevant recordings. For instance, someone could submit a phrase that does not translate correctly, or recordings in the incorrect language. These unwanted recordings are not only useless for education, but they could also potentially be offensive to the indigenous people. In order to keep the highest standards for learning capabilities while preventing offensive recordings from being public, a filtering system needed to be established. There were different types of filtering methods we could implement, so we needed to decide which one(s) suited our application and website best.

3.4.1. Creating a Moderated System

One filtering option was to create a moderated system in which a volunteer would sort through submissions and remove any recordings they found to be "junk." Junk submissions are any recordings that are improperly recorded, incorrectly translated, irrelevant, or are in some way not beneficial for educational purposes. The website is password-protected to allow only a select few to be able to approve or dismiss any submitted recordings. Having a moderator is beneficial because with only one person reviewing the recordings, it is easy to maintain consistency throughout the submissions. This consistency could also be a problem, though. It is possible that what the moderator deems "junk" is not necessarily useless to someone else. Another issue with having a moderator is that someone will have to actively maintain the database, which is very time consuming. It is unlikely for someone to take on this task as a volunteer; therefore, moderation will potentially cost our sponsors money.

3.4.2. Creating Flags

In order to identify the submissions that are inappropriate or offensive, a "flagging system" was designed for the application. Each recording has flag icon next to it and if a user listens to a recording and finds it unsuitable, they can simply click on the icon. This flagging system would make the job of a moderator less demanding. Instead of laboriously going through all of the submissions, the moderator would only need to review submissions that have been flagged by the users.

3.5. Finalized Application Features and Functions

By utilizing the VeniceNoise source code as well as Eclipse, Android SDK and other software and tools, we were able to create a fully functional application. A few of our designed features are still in the developmental stage, but hopefully the designs and mockups we created will aid future projects in the completion of the entire envisioned application.

3.5.1. Home Screen

The home screen of the application is fully functional. Selecting the "Browse Recordings" or "Record" functions will direct the user to the appropriate menu. Selecting any other option (Flashcards, Game, Search, Favorites) will prompt the user with a dialogue stating that these features are under development and will be accessible soon. We felt that including the ability to select these "under-development" icons and read this prompt will keep users excited about what TewaTalk will be able to do in the future with further programming and design.

3.5.2. Browse Recordings

The "Browse Recordings" function of our phone is fully operational. Anyone who downloads the application is able to search through a catalogue of over 550 professional-quality recordings. The recordings are classified under twenty five categories including; About Food, Animals, Colors, Daily Phrases and others (see Appendix C). Users can navigate from the broad categories, to specific recordings of that phrase. Selecting any recording will prompt the user with an information screen about the recording. From this screen, the user is also able to stream the recording directly from the MySQL database and access any information that has been attached. Users will also be able to learn the Tewa spelling of the word, the dialect used, the gender of the speaker and any notes that were submitted along with the recording

We have tested the capabilities of navigating through the database with a few volunteers and none of our participants

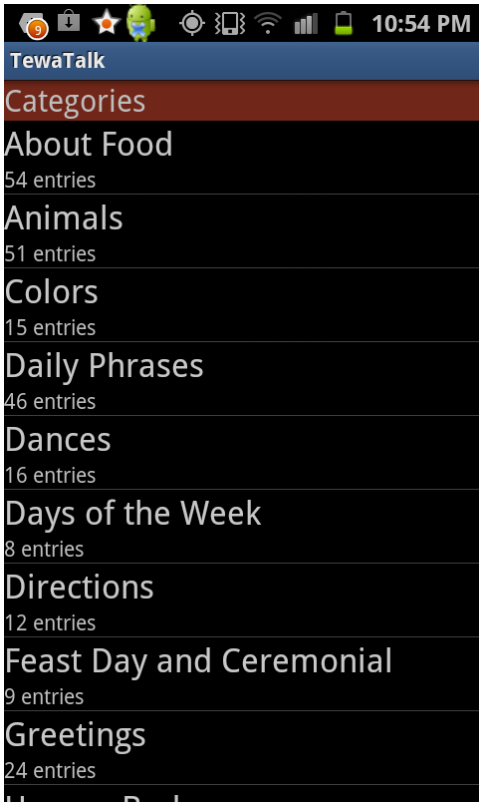


Figure 25: The "Browse" screen of the TewaTalk application

had any trouble finding any recording. The ease of navigation through our application shows that this function is a successful manner in displaying vast quantities of data so that it is easily navigated by users. The simplicity of the "Browse Recordings" function enables users to more easily access a recording and in turn, learn a Tewa phrase or word in a smaller span of time.

3.5.3. Submit Recording

The "Submit Recording" function of our phone is also fully operational. Users of TewaTalk are able to upload any recording of Tewa directly to our MySQL database. Submitted recordings are immediately available by the "Browse Recordings" function of the application.

When a user submits a recording, they are able to record their speech, play back the recording to ensure quality, and then add additional information to the recording. This information includes the Tewa spelling of the word, the dialect used, the gender of the speaker and any notes that the recorder finds important to cataloguing the recording.

We utilized user feedback to work out any bugs that may be present in our coding. For example, we discovered through testing a bug in which two submissions of the same phrase would be added to the MySQL database. Using user feedback helped us to create a better application that worked exactly to the specification laid out by the Pueblo of Pojoaque Language Committee.

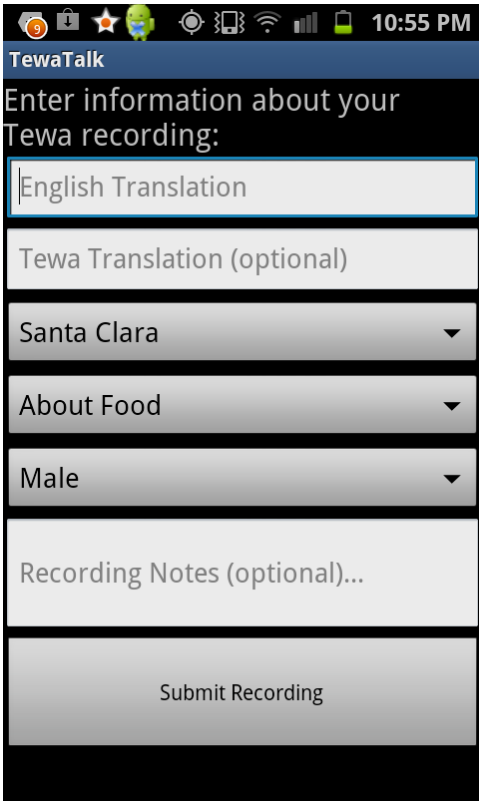


Figure 26: The "Submit Recording" screen of the TewaTalk application

3.5.4. Flashcard learning tool

Because of time constraints, we were not able to implement the flashcard learning tool onto the TewaTalk application. We did create an interactive mockup for the flashcards learning tool which is available for download on the website (see section 4.3.5). We have also explained our aspirations for the flashcard learning tool in more detail in our "Recommendations" section (see section **Error! Reference source not found.**).

3.5.5. Games

Because of time constraints, we were not able to implement the games onto the TewaTalk application. We did create an interactive mockup for the game which is available for download on the website (see section 4.3.6). We have also explained our aspirations for the game and leaderboard in more detail in our Recommendations section (see section 6.4.1).

3.5.6. Privacy

Because of the privacy issues with using the Android Market, we chose not to allow TewaTalk to be downloaded in this manner. Instead, we created a password protected Google-Site to store the TewaTalk .APK file.

Users who log onto our website will not be allowed to continue until they submit a request for authorization. Once the website administrator has granted authorization to the user, they will be free to access the entirety of the website and download the application by a QR-Code (see section 4.3.2).

4. The TewaTalk Website

We intend to have a website to supplement and enhance the mobile application by housing recordings and providing educational resources. To accomplish this, we designed an almost fully functioning TewaTalk website using Google Sites. This site serves as the basis for a more permanent, higher functioning website.

4.1. Website Design

As mentioned previously, the TewaTalk Google Site is an interactive design. It contains all of the components necessary for a successful, fully functioning website. Our design can be applied to an HTML-based website for the TewaTalk application, or can be used by any other team of people looking to create a language preservation website for their own language.

4.1.1. Website Design Constraints

During the process of creating the website, our group needed to overcome a few factors. First of all, this website needed to be created before the end of our project. The project wouldn't be complete if the preservation and education of the Tewa language was hindered because of the accessibility of the recordings. Because of the time constraint, a Google Site needed to be created in place of an HTML-based website. A separate server was necessary for uploading capabilities of the application.

4.1.2. Website Design Specifications

Because a Google Site was used as the TewaTalk website, we did not need to specify the type of internet browser the website needed to be operational as Google Sites can be viewed on any browser. Due to the sensitive nature of the indigenous Tewa language, the website needed to be password protected. Only users who have been approved by a moderator from the Tewa community have access to the website and its content.

4.1.3. Website Design Functionalities

Since we used a Google Site as the TewaTalk website, there are limitations that prevented us from having a fully functional website according to our initial plan. As a result, the TewaTalk

website is more of a design for a final HTML-based website than an actual fully functioning site. In our conversations with our sponsors, Ineé Slaughter and Felicia Rivera, we decided that the website would complement the application in many ways. Ideally, all of the recordings available on the application would be easily searchable through the website's databases, and users are able to listen to them. Currently, the Google Site includes the application script, and links from individual words and phrases to their corresponding recordings that can be listened to via an MP3 player gadget. There are also ways to request or flag recordings. Additionally, the website contains educational material such as a downloadable iBook version of the Santa Clara Tewa Dictionary by Esther Martinez and a "Just For Kids" section that contains recordings of nursery rhymes so children can be exposed to the language at an early age. The site also has mock-ups for games and a leaderboard that contribute to the design for a final product.

4.1.4. Designing the Layout of the Website

The purpose of the TewaTalk website is to provide educational resources and aid in the ability to recreate the application in addition to storing the recordings uploaded by TewaTalk Users. As mentioned previously, to create a layout design for a fully functional website, we used a Google Site. We wanted to make the website as interactive and educational as possible, meaning no page is just reading – there is always something for the user to do. The homepage of the TewaTalk website has a brief description of the website, and contains a word of the day section where the user can listen to a recording accompanied by the word written in Tewa and a corresponding image. Navigation throughout the website is provided by a horizontal navigation bar across the top of the page. In this bar, there are main links – some with drop-down menus that connect to sub links. The largest category on the website is the "Recording Dictionary". This section contains the entire categorized application script with hyperlinks from some words and phrases to the initial recordings we obtained. The group needed to ensure that the website design was easy to use and aesthetically pleasing. A simple red and white color scheme was used, and all links are written in a large and legible font in one location.

4.2. Prototyping the Website

Creating a prototype of the website to serve as our design involved using Google Sites, Google Forms, Google Gadgets, Microsoft PowerPoint and minimal HTML. Because the website is a design, there are many components that are mock-ups instead of actual working features. For

some of these components, such as the flashcards, the game, and the leaderboard, Microsoft PowerPoint was used. In addition to having several ways of creating animations, PowerPoint has a feature that allows the user to create hyperlinks from one slide to another. This allowed us to create an interactive experience for our game and our flashcards. In our game mock-up, the user looks at an image listens to three recordings in Tewa. They then choose the recording they think correctly corresponds to the image. If they guess correctly, they are brought to a screen that says, "Correct". If they guess incorrectly, they are brought to a different screen that tells them they are incorrect and links back to the choices so they may try again. In our flashcard mock-up, the user is presented with a card that has a word written in Tewa on it. If the user clicks once, the word is played aloud in Tewa. If the user clicks a second time, the card flips over to reveal the word written in English, accompanied by an image.

Figure 27: A screenshot of the Google Site serving as our website design

The rest of the features on the TewaTalk Google Site are working and usable. One feature is the ability to download the application using a QR-code. In order to prevent anyone outside of the native community from downloading the application, we decided to let the only way possible to download be via a QR-code on our password-protected website. This way the only people who have access to the application are moderator-approved users of the website. Other working features utilize Google Forms. For example, to flag a recording or to request an addition to the script, the user may fill out a simple form. The results of these forms are emailed to the moderator's Google account, who can see the responses and take action. We decided to use Google Forms for these features because they work well with the Google Site interface and, while they may not be as convenient as other systems of flagging or requesting things, they demonstrate what we want to happen in those sections of our website for the purpose of having a thorough design.

The team also utilized Google Gadgets and HTML boxes while prototyping the website. Google Sites do not have the ability to play a sound clip directly from a page without a gadget. The user has to first download the file before they can play it through some sort of media player. This makes it inconvenient to listen to the sound files and it initially prevented us from linking a script entry directly from this recording. To fix the problem, we used MP3 player Google Gadgets in conjunction with HTML boxes. First, we created subpages for each recording we had under each category of the script. We then uploaded the recordings to these subpages. We used MP3 player Google Gadgets in HTML boxes on each of these subpages as well, so the recordings could be listened to without needing to download them first. Eventually, these recordings will come directly from user uploads, but the recordings that are on the website now were uploaded by the team.

The remaining features on the TewaTalk website use built-in Google Site features such as the ability to link to outside pages or upload files (Tewa Dictionaries). In its current state, the website serves as a sufficient design for a more powerful HTML-based website.

4.3. Website Features and Functions

By using Google Sites and its various features, we were able to create a successful, partially functional, design for a HTML-based website. Each component of the design was made to aid in language education or the recreation and customization of the TewaTalk application.

4.3.1. About

The "About" section of the TewaTalk website contains information regarding the team and the creation of the application. There are four subsections in this category: "Creating a Script," "TewaTalk Source Code," "Helpful Links," and "Team". The first subsection, "Creating a Script" describes how our team went about creating the TewaTalk script from the one used in the Thornton Media "Cherokee Basic" application. It also includes a link to download the Word document that contains the complete script from the TewaTalk application that can be edited and customized. The second subsection, "TewaTalk Source Code" has a downloadable file that contains the source code for the TewaTalk application. We are making this free to anyone who has access to the TewaTalk website because we want users to be able to view everything that went in to the application so they could personalize it further if they want to. The third subsection, "Helpful Links," just has a list of links to external webpages that are useful to language preservation in general and pages we found useful while creating TewaTalk. The final subsection, "Team," has basic information about the project collaborators.

4.3.2. Download Application

The "Download TewaTalk" section of the website is fairly simple. It contains a QR-code that is linked to a direct download of the TewaTalk application APK file so that anyone who scans the code can download the app. We needed to figure out a way to ensure that only moderator-approved users could download the application, and this was our solution. Because the QR-code can only be accessed from our password-protected website, only approved users have the ability to download the application.

Figure 28: The "Download Application" page of the TewaTalk website

4.3.3. Recording Dictionary

The "Interactive Recording Dictionary" on the TewaTalk website is the largest, and arguably, most important feature. The "Interactive Recording Dictionary" page has subsections for each category in the application script. In each of the subsections is the list of script entries for that category. These subsections also have their own subsections for the script entries that we have initial recordings for. Every script entry that has a corresponding recording is a clickable link that brings the user to a page that has all of the recordings for that entry. The user can then listen to these recordings by clicking the play button on the Google Gadget MP3 player. This design allows for all user-uploaded recordings to be able to be listened to easily.

4.3.3.1. Flag a Recording

We wanted to ensure that our recordings are of the highest quality and that nothing inappropriate or incorrect has been uploaded to our server. To achieve this, we created a system of "flagging" unwanted recordings. On the "Flag a Recording" page, the user can fill out a Google Form that asks the user to: "Please submit the word or phrase that is unacceptable" and "Please tell us why this recording is unacceptable." When the user clicks, "Submit," their entries are immediately

archived in a Google Spreadsheet and the moderator is notified and can then remove the unacceptable recording.

4.3.3.2. Request a Recording

In the "Request a Recording" section, the user can do just that. There is another Google Form, similar to the form in the "Flag a Recording" section where the user is asked to: "Please enter the word, phrase, or category you would like added to TewaTalk." Once the user submits their request, it is automatically added to another Google spreadsheet where the moderator can view all submissions. If the request is valid and appropriate, the moderator can then add it to the TewaTalk script so users know to collect the phrase.

4.3.4. Tewa Dictionary

The application script does not contain every word in the Tewa dictionary, so the team thought it would be useful to have the whole dictionary accessible from the website. In this section, we have two downloadable forms of the Santa Clara Tewa Dictionary by Esther Martinez. One form is a Microsoft Word Document, and the other is an iBook specifically for iPad, created by the team. These separate forms make it possible for the user to look at the entire dictionary while sitting at their computer or on their iPad while on the go.

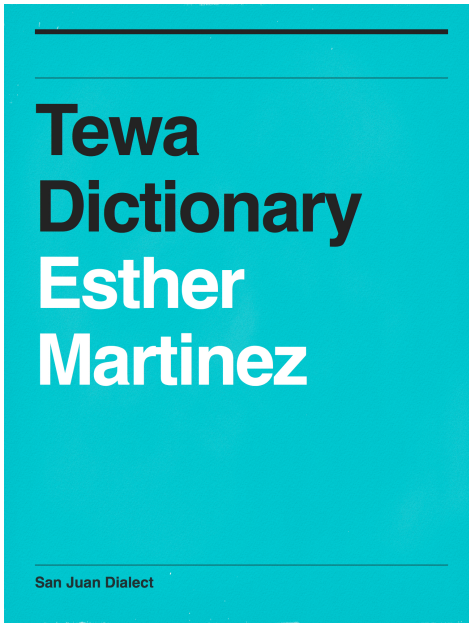


Figure 29: Front cover of the Tewa Dictionary iBook

4.3.5. Flashcards

In order to aid with Tewa language education, the team created interactive Tewa flashcards. (See Section 4.3.5) These flashcards are currently interactive mock-ups that will be more complete and have the ability to randomize on an HTML-based website (See Section 6.3). In this section of the website, users can download the interactive PowerPoint mock-up and go through the flashcards we have created so far.

4.3.6. TewaTalk Game

Similarly to the flashcards, the TewaTalk game is currently an interactive PowerPoint mock-up (See Section 4.2). In this section of the website, users can download the mock-up of the game to see what it will look like when the website is in HTML format (See Section 6.4.1). This game will be one of the ways in which users can earn points to potentially be listed on the TewaTalk leaderboard.

4.3.6.1. Leaderboard

Because there is not yet a working game or method of earning points, the leaderboard on the website is only an image of what we would like it to look like in the future. Potentially, users will be able to view the leaderboard on this page to see who has the most total points collected from the application (See Section 6.4).

4.3.7. Just for Kids

For preservation purposes, it is important for children to be exposed to Tewa as early as possible, so we decided to make a section of our website specifically for kids. This page, called "Just for Kids", contains recordings of common nursery rhymes sung in Tewa. These recordings can be listened to on the page or they can be downloaded directly to a user's computer. This way, parents have the ability to create CD's of the recordings if they choose to.

5. Conclusions

After completing our application and website, we reflected on what we have accomplished. We thought about how our application and website will be beneficial to the Pojoaque community and whether our project will be successful after we transfer ownership of our source code and data to them. We have provided a fully functional and working application to the Pueblo of Pojoaque, and hopefully, they will use our tools and designs to further our work and create a database of words and phrases that not only preserves the spoken language, but increases the number of fluent speakers.

5.1. Reflections on the TewaTalk Application

Before the start of our project, we doubted the ability of an Android smartphone to be an effective tool in language preservation. There was a large amount of concern whether or not an Android application would be useful as a learning tool for Tewa students or a beneficial method of recording and preserving the language. Over the course of eight weeks, we have collected over 550 recordings of the Tewa language as well as Tewa songs and pictures which will aid in the preservation of the Tewa language for future generations. Pojoaque members who speak Tewa are also capable of benefiting from our Android application by using the "Record" function to catalogue and preserve any words or phrases they find important to the continuation of Tewa.

Although filling the database with recordings will create a repository for future generations to study Tewa, we will not complete our objective to rejuvenate the language if the application is not used by students to learn Tewa. In order for this to be possible, our application has to be a capable learning tool for youth and teenagers to use in order to further their fluency of the Tewa language. Filling our database with professional-quality recordings of native speakers has made it possible for any Pojoaque teen with an Android smartphone to download our application and start learning Tewa immediately. By using the "Browse" function of our application, users are able to search through our online database of various words and phrases, listen to the phrase, and learn.

Although we have no data on the effectiveness of our application, we are confident that our application will be a success. We used various successful language programs such as Rosetta Stone and Thornton Media's Cherokee Basic application as a model for our application. Because these programs have proven to be effective tools for learning and language preservation, we are confident

that our application, which combines the best features of each of them, will also be a success. Our work has created a fully functional application, but it is now up to Pueblo of Pojoaque to use our application to its fullest potential; bolstering the database with more recordings, and promoting the application to their youth so they use it to learn.

We were also concerned over whether our application would be accepted by the Pojoaque Elders and other leaders within the Pueblo. After meeting with George Rivera, the Governor of Pojoaque, the Tewa Language Committee of Pojoaque, and many of the Tribal Elders, their unwavering support and enthusiasm for this project has made it possible for us to create an application that we believe will be beneficial to the preservation of the language. Because of Pojoaque's interest in the project, they have shown initiative in furthering and improving upon our application. This is important because, although we have created a fully functional application, there are many features that we were unable to finish and initiate. Because of the good reputation we have upheld, and the excellent work we have completed, other Worcester Polytechnic Institute students next year will be able to further our project and improve upon the groundwork for a language preservation application that we started.

5.2. Final Thoughts on the TewaTalk Website

Our website, although only in the design stages has also been accepted by the Pueblo of Pojoaque. We have created a functional prototype which serves as an excellent model for an education website which is used as the repository for all the collected recordings, as well as destination for all people, regardless of whether they use smartphones, to explore and learn more about the Tewa language. If our website is completed and implemented by future Worcester Polytechnic Institute students and members of the Pueblo of Pojoaque, the designs can be applied to other languages and serve as a useful tool for future generation to use for the preservation and rejuvenation of native languages.

At our presentation in the Santa Fe Indian School (SFIS) in front of many of the faculty and students of the school, there was a great interest from the crowd in involving the students in the continuation of the TewaTalk project. Involving students in the creation and implementation of iliTalk will foster their interest in learning and preserving their language and hopefully aid in the rejuvenation of many endangered language in New Mexico.

5.3. Final Thoughts on Language Privacy

As previously mentioned, privacy is one of the main obstacles when attempting to preserve the Tewa language. Each Tewa-speaking Pueblo prefers to keep their language to themselves even though the differences between dialects are minimal. At the Santa Fe Indian School, there is an opportunity for each Pueblo to select a teacher for their own indigenous language class for children from that Pueblo to attend. Currently, there are not any Tewa teachers at the school, but even if there were, only a limited amount of students would be able to attend. This is just one example of how keeping Tewa private hinders its preservation. This privacy issue also applies to TewaTalk. As of now, the application is only available to the Pueblo of Pojoaque, but it could be beneficial to all Tewa-speaking Pueblos. Obviously, if more people have access to our educational language preservation tool, the language has a greater chance of survival. We understand that language is an important part of native culture and that its boundaries should be respected, but we think it would be very advantageous to the Tewa language if it were more widely shared.

Though our application is only accessible by the Pueblo of Pojoaque, we hope that it will reach our target users (youth ages 13 and up) who are essential to language preservation. If more youth become fluent in Tewa, they will have the capability to pass the language on to their children, and so on. Our hope is that the game features of the application and website will be entertaining enough to keep our target users interested so they will continue to listen to learn by using the application.

TewaTalk has been received well by the community and is a promising language preservation tool. On its own, it cannot completely reverse the loss of Tewa, but it is a good start – especially if it can spark an interest among youth. TewaTalk provides good basic, and quickly accessible, knowledge of the language that will hopefully encourage further education.

6. Recommendations

Working with our time constraints, we have developed plans for future students or the Pojoaque people to improve our application and website. With our application completed, there are only a few other tasks that if completed will fulfill our ideal vision of the project.

6.1. Advancing the Application

Although the main features of the application have been finalized, there are some aspects of the application that still need to be improved. This includes the addition of the search bar, favorites, adding moderation to the application, and adding a voice-to-text feature.

6.1.1. Add a Search Function

Although our application currently has a feature to browse categories of words and phrases, there is no established way to search for specific words and phrases. Adding a search option will allow users to quickly find their desired phrase without the hassle of searching through all of the categories. This feature should be flexible enough to display phrases similar to the desired phrase. For instance, if "cat" was searched, the application should also display phrases such as kitty, or kitten. The search feature should work for both English and Tewa words.

6.1.2. Implement User Favorites

One main feature of the application that we would like to advance is the capabilities of the user's favorites. As stated in section, our application design allows for users to save recordings directly to their phone using the Favorites option. This allows for quick retrieval of their desired phrases. We would like to incorporate the methods of learning created by SuperMemo into the Favorites menu. SuperMemo is a learning method that helps the user to retain information easier. It is based on the science of long-term memory and developed the optimum timing for review of the learned material. This means that the phone will remind it's user of the word or phrase based on the last time that he or she has listened to it. The idea is that it will remind the user of the phrase right before he or she forgets it. The phone will remind the person to listen to it less frequently over the course of time as the person stores it in his or her long-term memory.

6.1.3. Moderation

Unlike our website, the application doesn't have any moderation available at this moment. A flagging method should be added to the application so that users can monitor recordings while they are away from a computer. The flagging option should be available on the phrase's entry screen. This allows the user to immediately notify the moderator if there is a phrase that is incorrect, inappropriate, or doesn't belong.

6.1.4. Voice-to-text

The Tewa language is mainly a spoken language, and their written form is not universally accepted. Having a voice-to-text feature on the application will minimize the need to have a written form. Users can search for the Tewa phrase verbally, and it should find the words that most closely match the desired phrase. Adding a voice-to-text for English is currently available to add into the application, but the addition of Tewa would make this application much more advanced.

6.2. Developing the Website

We are currently using Google Sites to store the collected recordings and serve as a template for the future website. It is extremely inefficient to store the recordings because each has to be manually entered into the specific webpage. Having another website will allow the recordings to be uploaded much easier, and will allow the user to listen or upload the recording much easier.

6.2.1. Establishing the constraints, specifications, and functionalities of the website

In order to create the website, there are a few factors that need to be taken into consideration. The website should be written in HTML and PHP to allow the page to be uploaded onto the server. Creating and accessing the website's database should also be created using MySQL.

There are different types of internet browsers available, and the website created needs to be operational on each browser as well as any tablets or other mobile devices. The website should also be password protected to ensure the privacy of the language, since the recordings should only be made available to the Tewa Pueblos. These specifications will prevent the language to spread publically, a major request from the Pojoaque language committee.

Gathering user ideas and feedback will be critical to the success of the website. In our conversations with our sponsors, Ineé Slaughter and Felicia Rivera as well as the Tewa Language

Committee, we decided that the website would complement the application in many ways. All of the recordings available on the application should be easily searchable through the website's databases, and users will able to listen to and flag them. Being able to search for key words or phrases allows users to easily find what they are looking for, and being able to hear the spoken language only enhances the educational value that our project was centered around. Additionally, the website should contain a section talking about the application and its role in language preservation.

6.2.2. Designing the Website

The main purpose of the application's website is to store the recordings collected from users. One page on the site should allow users to search the phrase database for prompt access to the recordings. The TewaTalk Google Site is an example of all of the features that we envision the website to have. This includes the homepage with the word of the day, the application creation resources, a QR code to download the application, the flashcard game, helpful links, the recordings, the leaderboard, a form to request a recording, the Santa Clara Tewa dictionary, the TewaTalk game, and videos related to Tewa or language preservation.

6.3. Initiating the Flashcards

In order for our application and website to successfully teach people, we plan on having a flashcard game available on both. The flashcard game will act as a learning tool, testing the user on the words and phrases collected. One form of the flashcard game will show a screen depicting the Tewa word and play the corresponding recording. The user will then have to click on the card to flip it over, revealing the English word and picture. This will also act in reverse, first showing the English, and the user has to come up with the Tewa verbal and written word or phrase. This will serve as practice for the game mentioned in Section 6.4.1. The flashcard mock-up is available on the TewaTalk Google Site.

Figure 30: Example of a flashcard

6.4. Launching the Leaderboard

To make learning the Tewa language more fun, we devised a leaderboard and point system. Each of the requested phrases will have designated points based on their complexity. The more intricate the phrase, the more points will be awarded to the user. Examples of the points for phrases will be available on the TewaTalk Google Site.

Table 1: Number of points for collecting recordings in the "Scavenger-Hunt" game

Word/Phrase Difficulty Level	Point Value
Easy	2
Medium	5
Difficult	10

6.4.1. Playing the TewaTalk Game

Along with collecting recordings, the user can also earn points by playing the TewaTalk word association game. This game is similar to the flashcards, and will continually grow as more words and phrases are recorded into the phone. This game should randomly generate each phrase with its associated picture found on the database, minimizing the need for human input in the game. In the game, the picture is first shown, and then three recordings will be played. As the user is listening to each recording, the phrase will be displayed so the user can see and hear each. Only one of the phrases will be the correct match to the picture, the other two phrases will be randomly selected from the database. The points will be awarded based on the number attempts needed to select the correct phrase (See Table 2**Error! Not a valid bookmark self-reference.**). This game could prove to be one of the most important features of our application and website. In order for TewaTalk to be a successful tool for language preservation, people need to use it frequently – that's where the game comes in. If there is a component to our app that is fun and entertaining, while providing educational material, users will be more inclined to use the app more often.

It would also be beneficial if a wider variety of games were created and added to the TewaTalk app and website. This way, users would have a greater variety of games to play and,

therefore, have a smaller chance of becoming bored with TewaTalk. These games could provide a range of different ways to test the user's knowledge (i.e. fill in the blank, matching, multiple choice, etc.) to appeal to a variety of learning styles and preferences.

Table 2: Number of points for answering questions correctly in the "Word Association" game

Attempt	Point Value
First	3
Second	2
Third	1

6.5. Gathering language statistics

After meeting with Anne Kandler, who created mathematical models of the Scottish Gaelic langauge, our group thought that it would be beneficial for the Tewa speaking Pueblos to gather statistics on their language such as population of bilingual Tewa speakers, monolingual Tewa speakers, and the fluency of all speakers. The mathematical models for Gaelic were based on over 100 years of meticulous census data. From this data, Kandler was able to depict the trend of the language and the number of new speakers yearly needed to keep the language from declining.[70] Our group would like to see these calculations being applied to Tewa, since this could help in the

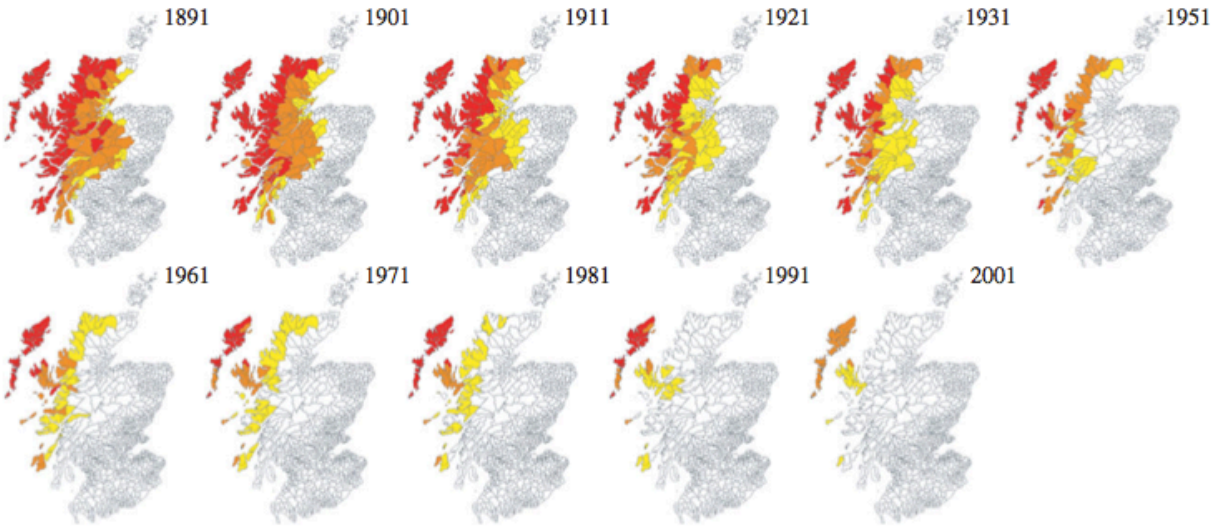


Figure 31: Population density of Scottish Gaelic speakers from 1891 - 2001

[70] (Kandler, Unger, and Steele 2010)

preservation of the language. However, more data is needed, which is why our group is recommending surveys of the fluency of Pueblo citizens and a game to test the fluency.

6.5.1. Survey to determine number of speakers

Anne Kandler noted that during the surveys, specific questions were asked to judge the fluency of each citizen. For example, the survey asked if the person could understand, speak, read and/or write Scottish Gaelic. This enhances the accuracy of judging a person's fluency. If the Tewa speaking Pueblos can gather fluency at least every 10 years, then they can soon judge if their language is declining and its magnitude.

6.5.2. Game

One way to determine a person's fluency is to test him or her through a game. We designed a fill in the blank game for this purpose. In the game, the user has to complete an incomplete Tewa phrase that is a translation of a given English phrase (see figure whatever). There will be several different levels of difficulty, from very easy to very difficult. Users will start at the easiest level and then work their way up as their language skills improve. Based on the accuracy of their responses (answers correctly after one guess, two, or three), they will also receive points towards the leaderboard. We hope that the game information from each user will be uploaded to a special, private, section of the TewaTalk website where it can be analyzed and used for the census. This game will help demonstrate individual levels of fluency based on the different levels of difficulty within the game. Users who are playing the game at a higher level will obviously be more fluent, at least with writing, than users at a lower level.

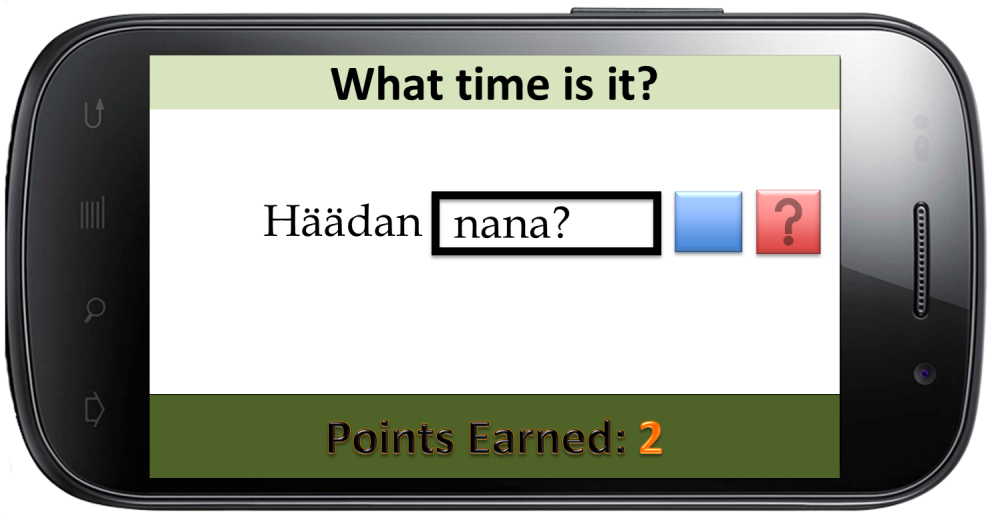


Figure 32: A mockup of the Tewa writing fluency game

As discussed in Section 6.4.1, it would be great to have multiple games within the application and website. It is possible that other games can be created that will help to test fluency in different ways. Having multiple methods of fluency testing will give more accurate data, and will therefore be more useful to the mathematical model mentioned in section 6.5.

6.6. Applying our Application to Other Languages

Our group would like to see this application being applied to any language that is suffering from language shift and language loss. In the future, we hope that all langauges will be able to use the tools we have created for TewaTalk, and apply them to their own language, whether that be Tiwa, Keres, Towa or any other indigenous language.

In a link on the TewaTalk website and in the future website, there will be an opportunity to download the application source code, the graphics from our application, and the script that we used to generate our initial recordings. The code and script can be easily edited to fit the need of any language. Anybody with a background in programming and computer science is welcome to take our free source code and alter it to fit their language.

The problem with our method of sharing our code is that it limits who is capable of using it as a tool to preserve their language. We want our application to be useful for languages other than Tewa as well as accessible by anyone regardless of technical background. To remedy this in the future, we created a design for a website called "iliTalk". iliTalk, when complete, will serve as a useful tool that will allow anyone with an internet connection to take action and begin the process of rejuvenating their language.

Figure 33: Example of a website and application for the Tiwa language created using the iliTalk creator

The design for iliTalk was created using Google Sites and Google forms. Users who want to create their own customized versions of TewaTalk simply fill out two forms. The first is a basic questionnaire asking for the name of the application, the name of the language, the desired

dialects, whether or not the content should be private, and the e-mail address and password of the creator. The next step in the process is to edit the script that we have generated. Users can look through each category to remove words and phrases that they do not want included or add words and phrases that are not currently in the script. After these two steps are completed, iliTalk instantly creates a customized application and website and provides a QR code to download the new app.

6.6.1. Santa Fe Indian School Involvement

As another way to involve other languages, the WPI and the Indigenous Language Institute would like to apply for a grant that will benefit the students at the Santa Fe Indian School. Getting the grant will create a program that allows students to learn how to make their own application for their native languages. This program allows them to learn more about computer software, programming, and their language.

6.6.2. The Future of iliTalk

As mentioned previously, the iliTalk website is a design so it does not actually create either the application, or the website, but it does provide a proof of concept. If the iliTalk Project is continued from our designs, the completed website will make it possible for people who do not have computer science background to create their own application and begin the process preserving their language creating new speakers of their language.

Bibliography

Bibliography

"Endangered Language Program: We Preserve More than Words." Rosetta Stone, http://www.rosettastone.com/global/endangered.

"Indigenous Language Institute." , accessed Jan 29, 2012, http://www.indigenous-language.org/.

"Jessie Little Doe Baird." , http://www.macfound.org/site/c.lkLXJ8MQKrH/b.6241221/k.5A66/Jessie_Little_Doe_Baird.htm.

"Key Global Telecom Indicators for the World Telecommunication Service Sector ." INTERNATIONAL TELECOMMUNICATION UNION, accessed February/29, 2012, http://www.itu.int/ITU-D/ict/statistics/at_glance/KeyTelecom.html.

"Langauge Tools for Indian Country." Thronton Media Inc., accessed 05/04, 2012, http://www.ndnlanguage.com/.

"Tewa Pueblos- Settlements." , http://www.everyculture.com/North-America/Tewa-Pueblos-Settlements.html.

Biedalak, Krzysztof and Piotr Wozniak. "Super Memory: Forget about Forgetting." , http://www.supermemo.com/index.htm.

Cantoni-Harvey, Gina. *Stabilizing Indigenous Languages* 1996.

Central Intelligence Agency. "Israel." The World Factbook, https://www.cia.gov/library/publications/the-world-factbook/geos/is.html.

Crawford, J. *Bilingual Education: History, Politics, Theory and Practice*. Los Angeles: Bilingual Educational Services. 4th ed. Los Angeles: Bilingual Educational Services, 1995.

Davis, Watsons. "Practical World Language." *The Science News-Letter* 62, no. 1 (Jul. 5, 1952): pp. 10-11. http://www.jstor.org/stable/3930872.

Dozier, Edward. "Kinship and Linguistic Change among the Arizona Tewa." *International Journal of American Linguistics* 21, no. 1 (1955): 242.

Estes, James. "Indigenous Languages Spoken in the United States (by Language)." National Clearinghouse for Bilingual Education, http://www.yourdictionary.com/elr/natlang.html.

Fellman, Jack. "Eliezer Ben-Yehuda and the Revival of Hebrew." , http://www.jewishvirtuallibrary.org/jsource/biography/ben_yehuda.html.

Fishman, Joshua A. *Reversing Language Shift*. Bristol, PA USA: Multilingual Matters Ltd, 1991.

Fishman, Joshua A. and Ebrary Academic Complete. *Can Threatened Languages be Saved?: Reversing Language Shift, Revisited : A 21st Century Perspective*. Vol. 116. Clevedon [England]: Multilingual Matters, 2001.

Fritz, Henry Eugene. *The Movement for Indian Assimilation, 1860-1890*. United States: 1963.

Harrington, John Peabody. *A Brief Description of the Tewa Language*. United States: 1910.

Jacobs, Sue-Ellen. "Tewa Pueblos." In *Encyclopedia of World Cultures*. Vol. 1, 347-350. New York: Macmillan Reference USA, 1996. http://ic.galegroup.com.ezproxy.wpi.edu/ic/whic/ReferenceDetailsPage/ReferenceDetailsWindow?displayGroupName=Reference&disableHighlighting=false&prodId=WHIC&action=2&catId=&documentId=GALE%7CCX3458000222&userGroupName=mlin_c_worpoly&jsid=7747c572ec295a466af91dcffa62b468.

Jefferson, Thomas. *Jefferson's Indian Policy* 1803.

Kandler, Anne, Roman Unger, and James Steele. 2010. "Language Shift, Bilingualism and the Future of Britain's Celtic Languages." *Philosophical Transactions of the Royal Society* (365).

Kappler, Charles J. "TREATY WITH THE CHOCTAW, 1830." the Oklahoma State University Library, accessed February/21, 2012, http://digital.library.okstate.edu/kappler/Vol2/treaties/cho0310.htm#mn1.

L. Lutz, Ellen. "Saving America's Endangered Languages." Cultural Survival, accessed Jan 24, 2012, http://www.culturalsurvival.org/publications/cultural-survival-quarterly/united-states/saving-americas-endangered-languages.

Lewis, M. P. "Ethnologue: Languages of the World." SIL International, accessed 16, , http://www.ethnologue.com/home.asp.

Lomawaima, K. Tsianina and Teresa L. McCarty. "When Tribal Sovereignty Challenges Democracy: American Indian Education and the Democratic Ideal." *American Educational Research Journal* 39, no. 2, Education and Democracy (Summer, 2002): pp. 279-305. http://www.jstor.org/stable/3202523.

Meyer, Rob. "the 6 most Influential Languages in the World, and how to Learn them Online for Free." , http://gobudgettravel.com/wp-content/uploads/2007/07/languages21.png.

Miller, Marjorie. "Revival of Hebrew Set Linguistic Precedent." *Los Angeles Times,*1998, sec. Observer.

Moseley, Christopher. "UNESCO Atlas of the World Languages in Danger." UNESCO Publishing, accessed March/1, 2012, http://www.unesco.org/culture/languages-atlas/index.php?hl=en&page=atlasmap.

Redish, Laura. "Native American Tribes of New Mexico." Native Languages of the Americas, accessed Jan 28, 2012, http://www.native-languages.org/nmexico.htm.

Romaine, Suzanne. "Preserving Endangered Languages." *Language and Linguistics Compass* 1, no. 1-2 (2007): January 23, 2012.

Sandercock, Leonie. *Making the Invisible Visible: A Multicultural Planning History*. Vol. 2. Berkeley: University of California Press, 1998.

Stewart, Jocelyn Y. "Esther Martinez, 94; Tewa Speaker Worked to Save Her Language." *Los Angeles Times,*2004, sec. Obituaries.

Appendices

Appendix A. UNESCO Data on Endangered Languages in the USA[71]

English Name	Level of Endangerment	Number of Speakers Left
Achumawi	Critically endangered	10
Ahtna	Critically endangered	25
Aleut	Critically endangered	150
Arikara	Critically endangered	10
Assiniboine	Critically endangered	150
Caddo	Critically endangered	25
Cahuilla	Critically endangered	30
Central Pomo	Critically endangered	3
Central~Sierra~Miwok	Critically endangered	3
Chemehuevi	Critically endangered	3
Chinook~Jargon	Critically endangered	
Coeur~d'Alene	Critically endangered	4
Columbian	Critically endangered	25
Gros~Ventre	Critically endangered	10
Han	Critically endangered	12
Hawaiian	Critically endangered	1000
Holikachuk	Critically endangered	5
Hupa	Critically endangered	12
Ingalik	Critically endangered	14
Ipai	Critically endangered	6
Kalispel	Critically endangered	5
Kashaya	Critically endangered	24
Kawaiisu	Critically endangered	10
Kiksht	Critically endangered	7
Kings~River~Yokuts	Critically endangered	6
Kiowa~Apache	Critically endangered	3

[71] Moseley, *UNESCO Atlas of the World Languages in Danger*

Klallam	Critically endangered	2
Konkow	Critically endangered	3
Koyukon	Critically endangered	150
Lake~Miwok	Critically endangered	3
LuiseÃ±o	Critically endangered	5
Lushootseed	Critically endangered	5
Maidu	Critically endangered	2
Makah	Critically endangered	12
Mandan	Critically endangered	10
Menominee	Critically endangered	35
Mescalero-Chiricahua~Apache	Critically endangered	3
Mono	Critically endangered	30
Mono	Critically endangered	40
Montana~Salish	Critically endangered	60
Munsee	Critically endangered	
Nez~Perce	Critically endangered	20
Northern~Paiute	Critically endangered	10
Northern~Paiute	Critically endangered	300
Northern~Pomo	Critically endangered	3
Northern~Sierra~Miwok	Critically endangered	6
Northern~Straits~Salish	Critically endangered	65
Omaha-Ponca	Critically endangered	50
Oneida	Critically endangered	2
Oneida	Critically endangered	10
Onondaga	Critically endangered	10
Osage	Critically endangered	10
Ottawa	Critically endangered	459
Panamint	Critically endangered	20
Patwin	Critically endangered	1
Pawnee	Critically endangered	10
Potawatomi	Critically endangered	50
Potawatomi	Critically endangered	50
Potawatomi	Critically endangered	50
Potawatomi	Critically endangered	50
Sauk-Fox	Critically endangered	200
Seward~Peninsula~Inupiaq	Critically endangered	2144
Seward~Peninsula~Inupiaq	Critically endangered	2144
Seward~Peninsula~Inupiaq	Critically endangered	2144
Southern~Pomo	Critically endangered	3
Southern~Sierra~Miwok	Critically endangered	3
Spokane	Critically endangered	2
Tanacross	Critically endangered	50

Tanana	Critically endangered	15
Tlingit	Critically endangered	300
Tolowa	Critically endangered	1
Tubatulabal	Critically endangered	3
Tule-Kaweah~Yokuts	Critically endangered	10
Tuscarora	Critically endangered	3
Upper~Kuskokwim	Critically endangered	25
Upper~Tanana	Critically endangered	55
Wichita	Critically endangered	10
Wintu-Nomlaki	Critically endangered	1
Yuchi	Critically endangered	5
Yurok	Critically endangered	12
Acoma-Laguna	Definitely endangered	4000
Alabama	Definitely endangered	275
Blackfoot	Definitely endangered	1000
Central~Siberian~Yupik	Definitely endangered	1000
Cherokee	Definitely endangered	10000
Cheyenne	Definitely endangered	1700
Creek	Definitely endangered	5000
Crow	Definitely endangered	3500
Havasupai	Definitely endangered	500
Hidatsa	Definitely endangered	200
Koasati	Definitely endangered	450
Koasati	Definitely endangered	450
Mescalero-Chiricahua~Apache	Definitely endangered	1500
Micmac	Definitely endangered	8145
Mohawk	Definitely endangered	3000
Mohawk	Definitely endangered	
Mohawk	Definitely endangered	
Northern`Paiute	Definitely endangered	400
O'odham	Definitely endangered	15000
O'odham	Definitely endangered	15000
Quechan	Definitely endangered	150
Rio~Grande~Keresan	Definitely endangered	6685
Southern~Tiwa	Definitely endangered	1600
Southern~Tiwa	Definitely endangered	1600
Taos	Definitely endangered	800
Arizona~Tewa	Definitely endangered	1600
Western~Apache	Definitely endangered	6000
Yaqui	Definitely endangered	510
Antoniano	Extinct	0
Arapaho	Extinct	0

Atsugewi	Extinct	0
BarbareÃ±o	Extinct	0
Catawba	Extinct	0
Cayuga	Extinct	0
Cayuse	Extinct	0
Central~Kalapuyan	Extinct	0
Chiwere	Extinct	
Cowlitz	Extinct	0
CupeÃ±o	Extinct	0
Eastern~Abenaki	Extinct	0
Eastern~Pomo	Extinct	0
Eel~River~Athabaskan	Extinct	0
Eyak	Extinct	0
Hanis	Extinct	0
Huron-Wyandot	Extinct	0
IneseÃ±o	Extinct	0
Island~Chumash	Extinct	0
Kansa	Extinct	0
Kato	Extinct	0
Klamath-Modoc	Extinct	0
Konomihu	Extinct	0
Lipan	Extinct	0
Lower~Chehalis	Extinct	0
Mattole	Extinct	0
Miami-Illinois	Extinct	0
MigueleÃ±o	Extinct	0
Molala	Extinct	0
Natchez	Extinct	0
New~River~Shasta	Extinct	0
Nisenan	Extinct	0
Nooksack	Extinct	0
Northeastern~Pomo	Extinct	0
ObispeÃ±o	Extinct	0
PurisimeÃ±o	Extinct	0
Quapaw	Extinct	0
Quileute	Extinct	0
Quinault	Extinct	0
Serrano	Extinct	0
Siuslaw	Extinct	0
Southeastern~Pomo	Extinct	0
Tillamook	Extinct	0
Tunica	Extinct	0
Tututni	Extinct	0

Twana	Extinct	0
Unami	Extinct	0
Upper~Chehalis	Extinct	0
Upper~Umpqua	Extinct	0
VentureÃ±o	Extinct	0
Wappo	Extinct	0
Western~Abenaki	Extinct	0
Wiyot	Extinct	0
Yuki	Extinct	0
Aleut	Severely endangered	150
Arapaho	Severely endangered	1000
Cherokee	Severely endangered	1000
Cheyenne	Severely endangered	400
Chickasaw	Severely endangered	600
Cocopa	Severely endangered	275
Comanche	Severely endangered	100
Gwich'in	Severely endangered	150
Jicarilla~Apache	Severely endangered	300
Karuk	Severely endangered	12
Kickapoo	Severely endangered	400
Kickapoo	Severely endangered	400
Kickapoo	Severely endangered	400
Kiowa	Severely endangered	400
Maliseet-Passamaquoddy	Severely endangered	500
Maricopa	Severely endangered	100
Mohave	Severely endangered	100
Mohave	Severely endangered	100
North~Alaskan~Inupiaq	Severely endangered	2144
North~Alaskan~Inupiaq	Severely endangered	2144
Ojibwe	Severely endangered	8000
Pacific~Gulf~Yupik	Severely endangered	200
Sahaptin	Severely endangered	100
Seneca	Severely endangered	100
Shawnee	Severely endangered	100
Shoshoni	Severely endangered	2000
Shoshoni (Nevada	Severely endangered	2000
Shoshoni	Severely endangered	2000
Southern~Paiute	Severely endangered	
Tanaina	Severely endangered	50
New Mexico Tewa	Severely endangered	1600
Tipai	Severely endangered	40
Ute	Severely endangered	100
Ute	Severely endangered	500

Ute	Severely endangered	300
Valley~Yokuts	Severely endangered	30
Washo	Severely endangered	24
Winnebago	Severely endangered	250
Winnebago	Severely endangered	250
Yavapai	Severely endangered	150
Central~Alaskan~Yupik	Vulnerable	10400
Central~Alaskan~Yupik	Vulnerable	10400
Choctaw	Vulnerable	9500
Choctaw	Vulnerable	9500
Choctaw	Vulnerable	9500
Hopi	Vulnerable	5000
Hualapai	Vulnerable	1000
Jemez	Vulnerable	3000
Mikasuki	Vulnerable	500
Navajo	Vulnerable	120000
Picuris	Vulnerable	225
Sioux	Vulnerable	25000
Upland~Yuman	Vulnerable	1650
Zuni	Vulnerable	9000

Appendix B. Cell Phone Operating System Data 2011[72]

Operating System	Shipments 2011 (millions)	Market share 2011	Annual growth
Android	237.7	48.80%	244%
iOS	93.1	19.10%	96%
Symbian	80.1	16.40%	-29.10%
BlackBerry	51.4	10.50%	5.00%
Bada	13.2	2.70%	183.10%
Windows Phone	6.8	1.40%	-43.30%
Others	5.4	1.10%	14.40%
Total	487.7	100%	62.70%

[72] *Key Global Telecom Indicators for the World Telecommunication Service Sector*

Appendix C. TewaTalk Script

Numbers

One

Two

Three

Four

Five

Six

Seven

Eight

Nine

Ten

**Add more numbers (to 29, 10's, 100's, 1000-3000, 1 mil)

Months

January

February

March

April

May

June

July

August

September

October

November

December

Days of the Week

Saturday

Sunday

Monday

Tuesday

Wednesday

Thursday

Friday

Time

Day

Week

Month

Year

Minute

Time

Clock

Future

Past

Present

Ancient time

Morning

Afternoon

Evening

Sunset

Sunrise

Night

Midnight

Today

Tonight

Tomorrow Night

Tomorrow Morning

Next week

Next month

Next year

Last week

Last month

Last year

Yesterday morning

Yesterday night

Day before yesterday

Night before last

Late

Early

What time is it?

It is 4 O'Clock

4:15

4:30

4:45

**How to say times of the day

Colors

Yellow

Red

Pink

Green

Blue

Brown

Orange

Purple/Violet

Gray

Black

White

Rainbow (multi-color)

Colors

Human Body

Hair

Head

Eye

Nose

Mouth

Teeth

Tongue

Eyebrows

Eyelashes

Chin

Beard

Ears

Neck

Back of neck

Back

Stomach, belly

Heart

Blood

Liver

Shoulders

Chest

Bellybutton

Elbow

Hand

Fingers

Thumb

Arm

Buttocks

Body

Leg

Thigh

Knee caps

Feet

Toes

Intestines

Bone

Ribs

Kinship Terms

Mother

Father

Grandmother

Grandfather

Paternal Grandmother

Uncle

Friend

Husband (or man)

Wife (or woman)

The Better Half

Love you

Love you, mother

Love you, father

Relatives

Great-Grandfather

Great-Grandmother

Older Sibling

Younger Sibling

Mother's Older Sister

Father's or Mother's Younger Sister

Father's Older Sister

Father's or Mother's Older Brother

Father's or Mother's younger Brother

Nephew

Elderly Male

Elderly Female

Granddaughter

Grandson

Mother-in-law

Father-in-law

Godmother

Godfather

Godchild

Daugher-in-law

Son-in-law

Midwife

Wedding Sponsor Mother

Wedding Sponsor Father

Child (son or daughter)

Animals

This is a…

This is a dog

Dog

Bear

Cat

Bird

Deer

Rabbit

Skunk

Horse

Eagle

Frog

Bug

Raccoon

Snake

Chicken

Crow

Hawk

Fish

Owl

Turkey

Buffalo

Spider

Wolf

Mouse

Elk

Coyote

Fox

Beaver

Otter

Gopher

Turtle

Lizard

Bat

Bobcat

Chipmunk

Cow

Donkey

Fawn

Ground hog

Mole

Pig

Pony

Rat

Sheep

Squirrel

Mountain Lion

Weather & Seasons

Spring

Summer

Autumn

Winter

It's a cold day

It's a warm day

How's the weather

The weather is good

The weather is bad

It is going to rain

It is raining

It is snowing

It is hailing

It is windy

It is sunny

The sky is dark

The sky is cloudy

The sun is setting

The sun is rising

Feast Day/Ceremonial

Creator

Great Spirit

Truth

Dream

God

Ground, Earth

Religion

Medicine man

Medicine woman

Jesus

Church

They are drumming

Materials & Items

Buckskin

Cloth

Hide

Blanket

Buckskin shirt

Moccasins

Beads

Scissors

Needle

Thread

Feathers

Canvas

Hooves

Shells

Metal

Outfit

Head dress

Breech cloth (g-string)

Belt

Shawl

Necklace

Bells

Rattle

Bow & Arrow

Tablita

Kilt Cloth

Manta

Jewelry

Earrings

Bracelets

Barrette

People

People

Woman

Man

Child, little one

Baby

Boy

Girl

Little Girl

Teenage Girl

Little Boy

Teenage Boy

Boss

Old man

Old woman

Chief

Elders

Children

Deceased

White people

Indian people

Black people

Mexican people

Asian people

Person with mixed ancestry

Indian Man

Indian Woman

White man

Mexican

English

Indian Tribes and Pueblos

Santa Clara Pueblo/person from Santa Clara

Laguna Pueblo / person from Laguna

Cochiti / person from Cochiti

Nambe / person from Nambe

Ohkay Owingeh / person from Ohkay Owingeh

Taos / person from Taos

Picuris / person from Picuris

San Carlos Apache

Jicarilla Apache

Pojoaque / person from Pojoaque

San Ildefonso / person from San Ildefonso

Santa Ana / person from Santa Ana

Santo Domingo / person from Santo Domingo

Tesuque / person from Tesuque

Acoma / person from Acoma

Isleta / person from Isleta

Jemez / person from Jemez

Navajo / Navajo person

Sandia / person from Sandia

San Felipe / person from San Felipe

Zia / person from Zia

Zuni / person from Zuni

Greetings

Hello

Greetings without traslations

Welcome to our home

How are you?

Hello, how are you?

I am fine

Have a nice day

Thank you

I love you

Where are you from?

I am from…

I am Tewa from…

Where do you live?

Are you Indian?

Do you speak Tewa?

What is your name?

My name is

What is your family name?

Fabio (man's name) is my name

You speak Tewa very well

I do not speak Tewa well

I am glad to meet each other

See you later

Good Morning

Good Afternoon

Good Evening

Good Night

Goodbye

See you later

Kids Phrases

Mother, I love you

Father, I love you

I love my grandma

I love my grandpa

I am happy

I am hungry

I am thirsty

I want some water

I am scared

I am angry

He hit me

She hit me

I like that kid

I don't like that kid

You stink

Who farted?

This is funny

This is fun

I want to go play

I want to play ball

I want to play with my friend

I want to play dolls

I want to watch TV

I don't want to go to school today

I am not feeling well

I forgot to do my homework

Daily Phrases

Yes

No

OK

Thank you

Bless you (sneeze)

Wake up

I need to use the bathroom

Where is the bathroom?

Wash your face

Brush your teeth

Comb your hair

Eat your breakfast

Feed your brother and sister

Go to school

What did you learn today?

Do the work your teacher gave you

Did you finish your homework?

Go play outside

Who are you playing with?

What's your friend's name?

Come inside the house

Don't talk to anyone you don't know

Be polite

Respect your elders

Clean your room

Help me in the kitchen

Behave

Stop arguing

Please

Thank You

You can have it

You cannot have it

Don't

You are a good girl

You are a good boy

You are being a bad girl (spoiled)

You are being a bad boy (spoiled)

I hate you

Forgive me

Turn off the television

Come eat dinner

Help me clean the table

Help me with the dishes

Help me with the laundry

Help your dad

Help your dad outside

Held your dad inside

Go to bed

About Food

Are you hungry?

I am hungry

I am not hungry

Come to eat (group)

Come to eat (single person)

I want something to eat

Food

Can I have some food?

Do you have any food?

What do you want to eat?

What do you want to drink?

Is there anything to eat here?

You don't have to cook

I want some water

I want some food

I want some potatoes

I want some bread and butter

I want some eggs and bacon

I want some green beans

I want some vegetables

I want some fruits

I want some meat

I want some hamburgers

I want some frybread

I want some cake

I want some pie

I want some desserts

I want some coffee

I want some cold drink

I want some candy

I want some ice cream

Pass the salt and pepper

Please give me the beans

Please give me the…

The beans are very good

The food is great!

The food is not so good

This is a good restaurant to visit

The service is terrible

Garbanzo

Red & Green chile

Chico

Potato Salad

Oven Bread

Tortillas

Jellos

Piki Bread

Tea

Indian Tea

Salad

Yams

Sugar

Wild Spinach

Wild Parsley

Tobacco

Atole

Choke Cherry

Salt

Apple

Peach

Melon

Lard

Oil

Butter

Fried Bread

Flour

Blue Cornmeal Mush

Corn

White Corn meal

Cornmeal

Posole

Corn Tortilla

Potato

Bread pudding

Oven bread

Pear

Meat

Pumpkin

Plum

Prune

Strawberry

Watermelon

Stew

Soup

Tamale

Onions

Dough

Tomato

Beans

String Beans

Peas

Chicos

Egg

Milk

Spinach

Apricots

Carrots

Cherries

Grapes

Beets

Fresh Corn

Nature

Tree

Flowers

Bush

Branch

Leaf

Rainbow

Sun

Moon

Star

Sky/Heaven

Cloud

Mountain

River

Lake

Ocean

Universe

Prairie, Flat land

Arroyo

Ditch

Boundary

Land

Field

Hill

Hole

Meadow

Road

Cliff

Cave

Tribal Officers

George Rivera is the Governor of Pojoaque

Joseph Talachy is the Lt. Governor of Pojoaque

Market

Money

He paints pictures

He makes pretty work

She makes beadwork

He makes baskets

How much are you asking for it?

That's a lot!

It's worth it

How long did you take to make this?

I'd like to buy it

Let's make a deal

Milestones of Life

Birth

Death

Graduation

Young Adults

Old Age

Marriage

Initiation

Baptism

Divorce

Occupations

Warchief

policeman

blacksmith

Shoe repairman

seamstress

belt-maker

banker

Dance costume maker

Teacher

Cook

farmer

salesman

welder

silversmith

potter

Engineer

Priest, minister

Baker

rattle-maker

fireman

carpenter

hairdresser

rainsash maker

leggings maker

Pilot

Writer

artist, photographer

highway/construction worker

basket-maker

mechanic

Chauffeur

Doctor, nurse

Dances

Bow and Arrow Dance

Slow Evening Dance

Harvest Dance

Black buffalo Dance

White buffalo Dance

Corn Dance

Yellow corn Dance

Matachine Dance

Turtle Dance

Deer Dance

Social Dance

Cloud Dance

Comanche Dance

Dog Dance

Eagle Dance

Butterfly Dance

Directions

He is going…

Where are you going?

I am going…

South

North

East

Right

Up

Down

In-front

Behind

Near

Far

West

Horizon

Left

Appendix D. Mock-ups of TewaTalk Application

Appendix E. Mock-ups of TewaTalk Website

Home | Download Application | Recording Dictionary | Tewa Dictionary | Flashcards | Tewa Talk Game | Just For Kids | About

Download Application

Download the Tewa Talk application by scanning the QR code below!

The Tewa Talk application was created by a group of students from Worcester Polytechnic Institute in conjunction with the Indigenous Language Institute to help contribute to the preservation of the Tewa language of the Pueblo of Pojoaque. Tewa Talk allows users to collect recordings of Tewa speakers and upload them to a server so all users have access. These recordings can be accessed from both the application and this website. We hope that this application will help members of the Pueblo of Pojoaque learn Tewa.

Home | Download Application | **Recording Dictionary** | Tewa Dictionary | Flashcards | Tewa Talk Game | Just For Kids | About

Recording Dictionary

About Food
Animals
Colors
Daily Phrases
Dances
Days of the Week
Directions
Feast Day/Ceremonial
Greetings
Human Body
Indian Tribes and Pueblos
Kid Phrases
Kinship Terms
Market
Materials and Items
Milestones of Life
Months
Nature
Numbers
Occupations
People
Time
Tribal Officers
Weather and Seasons

Learn Tewa by listening to user recordings! We strive for the highest quality recordings, so if you find a recording that is subpar, please let us know by flagging the recording.

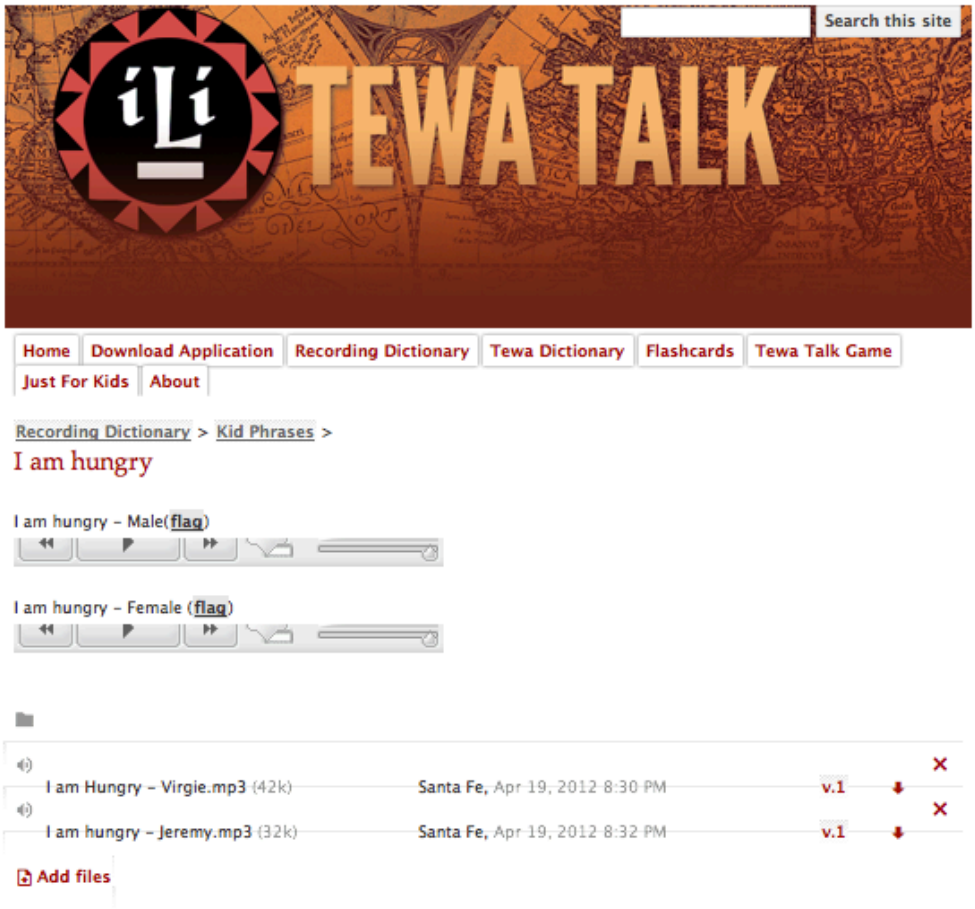
Home | Download Application | Recording Dictionary | Tewa Dictionary | Flashcards | Tewa Talk Game | Just For Kids | About

Recording Dictionary >

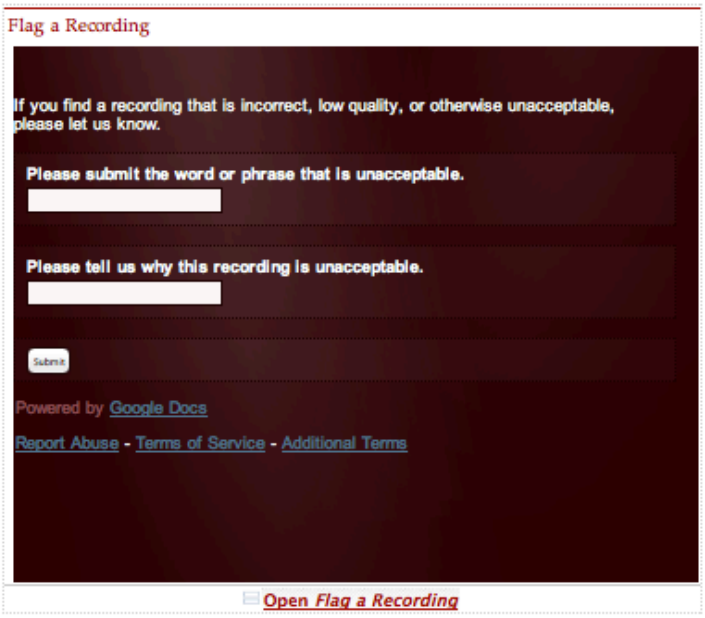
Kid Phrases

- Mother, I love you
- Father, I love you
- I love my grandma
- I love my grandpa
- I am happy
- I am hungry
- I am thirsty
- I want some water
- I am scared
- I am angry
- He hit me
- She hit me
- I like that kid
- I don't like that kid
- You stink
- Who farted
- You smell like farts
- This is funny
- This is fun
- I want to go play
- I want to play ball
- I want to play with my friend
- I want to play dolls
- I want to watch TV
- I don't want to go to school today
- I am not feeling well
- I forgot to do my homework

Subpages (7): He hit me I am angry I am hungry I am thirsty I want to play with my friend This is fun You smell like farts

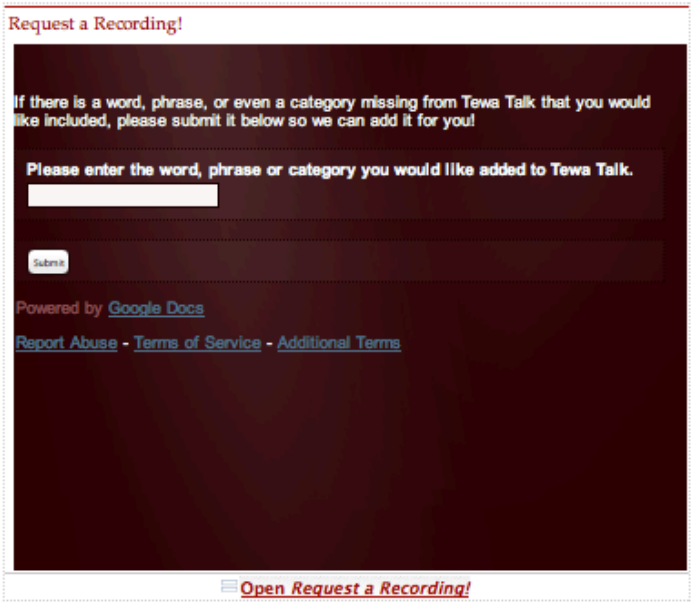

Search this site
TEWA TALK
Home
Download Application
Recording Dictionary
Tewa Dictionary
Flashcards
Tewa Talk Game
Just For Kids
About
Recording Dictionary > Kid Phrases >
I am hungry
I am hungry – Male(flag)
I am hungry – Female (flag)
I am Hungry – Virgie.mp3 (42k) Santa Fe, Apr 19, 2012 8:30 PM v.1
I am hungry – Jeremy.mp3 (32k) Santa Fe, Apr 19, 2012 8:32 PM v.1
Add files

Flag a Recording



Home | Download Application | Recording Dictionary | Tewa Dictionary | Flashcards | Tewa Talk Game | Just For Kids | About

Request a Recording



Home | Download Application | Recording Dictionary | **Tewa Dictionary** | Flashcards | Tewa Talk Game | Just For Kids | About

Tewa Dictionary

Below are links to download the San Juan Pueblo Téwa dictionary written by Esther Martinez in both a Microsoft Word Document and as an iBook for iPad.

Subpages (1): Orthography and Pronunciation

W	SAN JUAN PUEBLO TÉWA DICTION...	Karin Greene, Mar 26, 2012 2:06 PM	v.1	✕
	San_Juan_Tewa_Dictionary.ibooks (145	Karin Greene, Apr 24, 2012 5:24 PM	v.1	✕

Add files

Orthography and Pronunciation

Alphabet

The written Tewa language is based upon an English version of the Roman alphabet. Historically, the Tewa language did not have a written form, it was only recently that English characters were applied to Tewa.

Phonology

Tewa speech is excessively nasal and much broken by the glottal stop. Like Chinese, it makes use of "tones." There are 45 distinct "individual sounds"; twelve of these sounds are vowels and may be long or short.

Short Vowels

Letter	Tewa Word	English Translation	Phonene	Similar to
A	nava	'field'	/a/	a in father
E	the	'wagon'	/e/	e in mesa
I	sí	'six'	/i/	I in machine
O	to	'shirt'	/o/	o in obey
U	sú	'arrow'	/u/	u in rule
Ä	puvä	'worm'	/ae/	a in cat

Long Vowels

Letter	Tewa Word	English Translation	Phonene	Similar to
Aa	paa	'fish'	/a'/	aa in aardvark
Ay	tay	'tree'	/e'/	ay in say
Ee	dee	'chicken'	/I'/	ee in see
Oe	poe	'pumpkin'	/o'/	oe in toe
Uu	puu	'rabbit'	/u'/	like u, but longer
Ää	dää	'taste'	/ae'/	like ä, but longer


Search this site
TEWA TALK
Home
Download Application
Recording Dictionary
Tewa Dictionary
Flashcards
Tewa Talk Game
Just For Kids
About
Flashcards
Khâaveh
Eight
8
Flashcard_Mockup.pptx (929k)
Santa Fe, Apr 19, 2012 10:01 PM
v.1
Add files

Home | Download Application | Recording Dictionary | Tewa Dictionary | Flashcards | Tewa Talk Game | Just For Kids | About

Tewa Talk Game

Recording A

Recording B

Recording C

Game_Mockup.pptx (1083k) Santa Fe, Apr 19, 2012 10:05 PM v.1

Leaderboard

Home | Download Application | Recording Dictionary | Tewa Dictionary | Flashcards | Tewa Talk Game | Just For Kids | About

Just For Kids

All songs recorded by Eva Mitchell at the Indigenous Language Institute

Intro to Children's Nursery songs

1-2-3 Children

Children are here today

Goodbye song

Home | Download Application | Recording Dictionary | Tewa Dictionary | Flashcards | Tewa Talk Game | Just For Kids | About

About

The subpages in this section contain information that helped our team in the creation of the Tewa Talk application. We want to share this information so the users have access to everything we made for them.

Subpages (2): Creating a Script Tewa Talk Source Code

Add files

Comments

Add comment

Appendix F. TewaTalk QR-Code