



THE UNIVERSITY
OF BRITISH COLUMBIA

Evaluating Indigenous speech synthesis for education: A participatory design workshop on Ojibwe text-to-speech

Viann Chan, Christopher Hammerly
Department of Linguistics
University of British Columbia
Vancouver, Canada



Indigenous Language	Team
<ul style="list-style-type: none">• Plains Cree (Central Algonquian)• Kanyen'kéha	<ul style="list-style-type: none">• Harrigan et al., 2019• Saunders, 2008
Kanien'kéha (also known as Mohawk; Iroquoian), Gitksan (Tsimshianic), and SENCO 'TEN (Coast Salish)	Pine et al., 2022, 2025
Anishinaabemowin (Ojibwe)	Hammerly et al., 2023
Cherokee	Conrad, 2020

About Ojibwe

3

Indigenous language in the Algonquian family, spoken in the US and Canada

High average age of L1 speakers
+
Parent generation unable to speak language with their children at home

Most instructors of Ojibwe identify as teacher-learners



<https://www.tadtribalart.com/map-ojibwa-people>

Anishinaabemodaa

Waking Up Ojibwe

Language Learning Platform

App developed by:
CultureFoundry Studios,
Victoria, BC

TTS developed by

- **Department of Linguistics,**
UBC, Vancouver, BC
- **SayItFirst,** Halifax, NS
- **CultureFoundry Studios,**
Victoria BC



The Ojibwe TTS System

5

VITS Model: Parallel end-to-end model trained using the Coqui AI TTS Library

Data Training Set: Utterances recorded by heritage speaker collaborator, included edited audio file and associated transcription in double vowel orthography

(Hammerly et al., 2023)

A text-to-speech synthesis system for Border Lakes Ojibwe

Christopher Hammerly, Sonja Fougère

Department of Linguistics
University of British Columbia
Vancouver, Canada

chris.hammerly@ubc.ca
sonjaf16@student.ubc.ca

Giancarlo Sierra, Scott Parkhill

Harrison Porteous, Chad Quinn
CultureFoundry
Victoria, Canada

giancarlosierra, scottparkhill
harrison, chadquinn
@culturefoundrystudios.com

Abstract

This paper describes the development of a text-to-speech synthesis system for Border Lakes Ojibwe, which is being deployed within a web-based language learning platform. We discuss our approach to community engagement, recording and editing transcribed sets of utterances for model training, the technical implementation of the speech synthesis model itself, how the system is being used by teachers and learners within the web-based platform, strategies for future extensions of this type of work to other Indigenous voices, dialects and languages, and possibilities for applications in additional educational contexts and beyond.

1 Introduction

Ojibwe (known by speakers as Anishinaabemowin) is an Indigenous language of the Algonquian family consisting of a diverse set of mutually intelligible varieties spoken throughout large swaths of what is colonially known as Canada (through much of

We describe an initial project that has built these tools for use by language instructors and learners in school and community settings within the Treaty #3 lands of Northwestern Ontario, where the Border Lakes variety of the Southwestern Ojibwe dialect group is spoken (Valentine, 1994). We especially focus on our process for creating training data for Indigenous speech synthesis systems.

2 Background

2.1 Positionality and community engagement

The project was initiated by the Seven Generations Education Institute in Fort Frances, Ontario as part of their *Anishinaabemodaa* “Waking up Ojibwe” language initiative, and has been conducted in collaboration with a team of researchers at the University of British Columbia, the Halifax-based language revitalization organization SayItFirst, and the Victoria-based educational start-up CultureFoundry. We include positionality statements from each member of the team who has worked directly

Text to Speech

Language

Ojibwe



Select language from drop down menu

Enter a word or sentence

Boozhoo



SPEAK

Press this button to generate audio



0:00 / 0:01



Press three dots to view drop down menu, option to adjust playback speed and download audio clip

Press play button to listen to audio

Research Questions



1

What are the strengths and limitations of our existing Ojibwe TTS feature?

2

What are teachers' priorities when approaching new tools in educational technology like TTS?

How are you evaluating this tool?



Participatory Design Methods

Research participant
= Subject-matter expert in their community's needs

(Zelenko et al., 2021; Flaskerud & Anderson, 1999)

Indigenous PD methods

- Prioritize rapport-building
- Data: narratives and stories

(Woodward & Marrfurra McTaggart, 2016;
Barcham, 2013)



Human computer interaction co-design methods

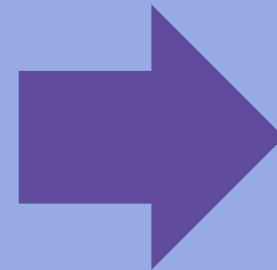
- Systematic and rigid
- Data: tangible design products, recommendations for improvement of technology

(Roschelle et al., 2006;
Lin & Van Brummelen, 2021)

Method Overview

Pre-workshop Qualtrics
questionnaire
~ 1 hour

1. Demographic survey
2. Guided trial of TTS feature
3. User experience survey



Workshop on Zoom
~ 2 hours

Total time commitment: 3 hours

Guided Trial Example

11

Try entering one word into the text-to-speech system, record what you entered below:

Boozhoo

To what extent do you agree with the following:

The word was sounded out accurately Agree

The tone of voice was contextually appropriate Strongly Disagree

Strongly Disagree

Disagree

Agree

Strongly Agree

Not Applicable

Powered by Qualtrics

Text to Speech

Language: Ojibwe

Enter a word or sentence: Boozhoo

SPEAK

0:00 / 0:01

Purpose:
Ensure participants had the opportunity to explore the TTS feature fully on their own, free from influence from researchers and other participants

Workshop Zoom Whiteboard Set-up

1. Rapport-building
2. Brainstorming activity
3. Sorting activity
4. Choose one idea to develop
5. Develop lesson plan
6. Debriefing the activity
7. Personal reflection

Brainstorm Area

Frame 1

Some sticky notes include:

- "If it is easy for the app to generate an assessment for the different modules, it would be much easier for teachers to get grades."
- "It would be great to use when I'm creating the assessments."
- "This is a great idea, especially for quizzes - students can listen and spell or even better listen and respond in dialogue form."
- "My students hear the words of phrases and then they are asked to write them. Because I become specific, I can check their work. I can see the words it is being shown to."
- "Many of my students prefer auditory learning so this is extra helpful to differentiate."
- "Co-create a phrasebook with my students that includes audio files for the phrases we come up with."
- "It would be great to use it for learners to actively translate from listening to an audio."
- "I like the idea of understanding the long and short sounds of the vowel chart. Because I can then write the sounds on paper, because they are trying to hear words using the English sounds other than the sounds from the vowel chart... if that makes sense."
- "I think another great idea would be for them to actively pick out phrases maybe that we can use in the classroom so they can listen to the audio and be more confident in their speaking!"
- "Putting a story into the feature to hear it read; helpful for having students learn and recall longer passages and give them the confidence to know they are pronouncing words correctly."
- "I think another great idea would be to have the teacher read the story and then the students can be asked to read it back to them. This would be a great way to check their understanding of the story and also to practice their reading skills."
- "Create storybooks that come with audio files."
- "My students created stories this year and used audio files for that. They will be able to access this as well."
- "Yes, I think the learners themselves would greatly appreciate being able to use this feature if it was available in a 1:1 setting!"
- "I like the idea of putting in questions, or that the students can listen to them. It would be great to have the students ask questions about the story."

Sorting Area

Frame 2

Let's discuss these!

Frame 3

Maybe if we have time

Frame 4

Save for another

Lesson Planning

Age group (Can be all ages):

Goal: to co-create a phrasebook as a class

Begin by teaching introductions, useful phrases, questions they ask frequently of each other, getting to know you phrases, teacher commands, numbers, classroom items, feelings emotions, family members

As we learn this vocabulary, we create the phrasebook so it is a living document of our learning.

"Phrase of the day" - students record the phrase with the audio file in a document they get to keep as an ongoing resource.

Materials needed: online template for the phrasebook

First introduction teacher would model how to write/spell the word and then how to generate the audio file and embed it in the template

How can the project benefit community efforts at language maintenance and revitalization?

**Inclusive
Education**

**Encouraging
Language Use**



How can the project benefit community efforts at language maintenance and revitalization?

Inclusive Education

- Help implement accommodations
- Support students who struggle with reading and writing
- Create multimodal learning materials
- Offer alternative assessment options

How can the project benefit community efforts at language maintenance and revitalization?

Inclusive Education

- Help implement accommodations
- Support students who struggle with reading and writing
- Create multimodal learning materials
- Offer alternative assessment options

(1) Practice Phase

- Input terms from vocabulary list into TTS feature
- Listen to audio, practice pronunciation

(2) Create Flashcards

- Record self reading vocabulary word
- Use flashcard software or PowerPoint to put word on one slide/ side then audio clip on the next

Boozhoo

Side A

▶ 0:00 / 0:01 ——— 🔊 ⋮

Side B

How can the project benefit community efforts at language maintenance and revitalization?

Inclusive Education

- Help implement accommodations
- Create multimodal learning materials
- Offer alternative assessment options
- Support students who struggle with reading and writing

Make-Your-Own Phrasebook

1. Download audio clip of phrase from TTS feature
2. Add audio clip next to text of phrase
3. Periodically update phrasebook

Sample

My Phrasebook



agongosens

▶ 0:00 / 0:01 ——— 🔊 ⋮



mashkode-bizhiki

▶ 0:00 / 0:01 ——— 🔊 ⋮



waabooz

▶ 0:00 / 0:01 ——— 🔊 ⋮

How can the project benefit community efforts at language maintenance and revitalization?

Encouraging Language Use

- Encourage students to practice speaking and listening at home
- Increase exposure to language outside of the classroom
- Support community effort to educate students

What are some challenges you encountered and how did you address them?

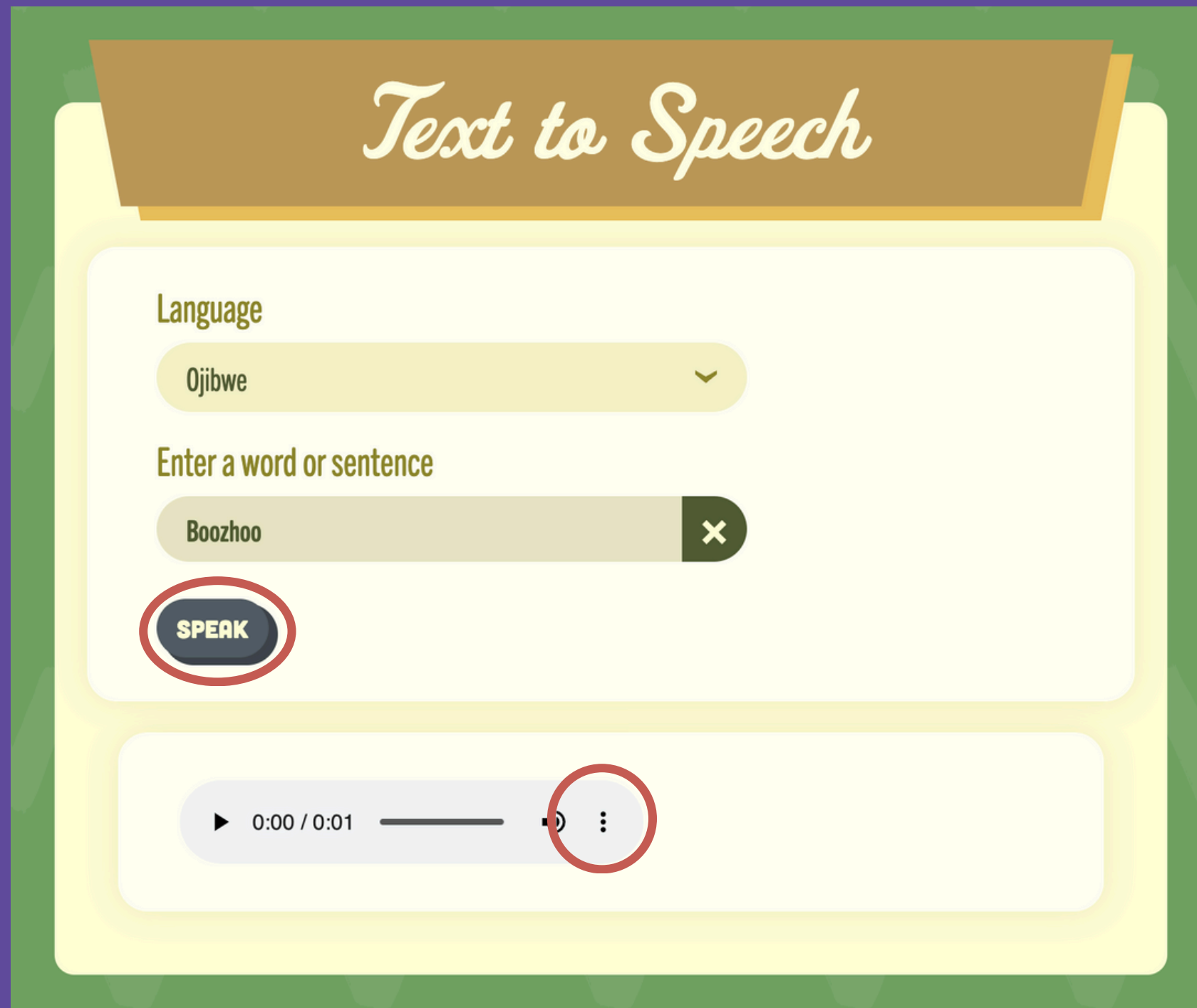
Accessibility

Issues with
Literacy

Lack of
Representation



What are some challenges you encountered and how did you address them?



Accessibility

- Using TTS not an intuitive experience:
- “Speak” instruction unclear
 - Function of three dots unclear

What are some challenges you encountered and how did you address them?



Accessibility

Using TTS not an intuitive experience:

- “Speak” instruction unclear
- Function of three dots unclear

How to address

- Change language used to be a balance between technical and user-friendly
- Add more instructions to interface

What are some challenges you encountered and how did you address them?

Literacy

- Correct spelling in standard orthography needed to generate accurate synthetic speech output
- Spelling is challenging for some
- Dialect differences

What are some challenges you encountered and how did you address them?

Literacy

- Correct spelling in standard orthography needed to generate accurate synthetic speech output
- Spelling is challenging for some
- Dialect differences

How to address

- New multilingual model allows for more flexibility in writing system (Wang et al., 2025)
- Spell-check mechanism (Hammerly et al., 2025)

What are some challenges you encountered and how did you address them?

Lack of Representation

- Only one voice option of a middle-aged male on the TTS feature
- Ethical concerns regarding use of likeness

What are some challenges you encountered and how did you address them?

Lack of Representation

- Only one voice option of a middle-aged male on the TTS feature
- Ethical concerns regarding use of likeness

How to address

- Use of Multilingual TTS instead of VITS → Faster generation of synthetic speech, fewer samples needed to train
- New adult female voice trained
- Modulation of voices

What lessons have you learned that might benefit similar collaborations?



Lessons Learned

1

Building trust and rapport is as much a priority as meeting the aims of the study.

Understand challenge of being open with strangers

Plan ample time for rapport building

Accommodate different styles of communication

Setting expectations:
“All ideas are good ideas”
“This is a safe space”

Lessons Learned

2

A role-reversal in the researcher-participant dynamic is beneficial to community collaborations.

Researcher seeking to learn from participant (subject-matter expert)

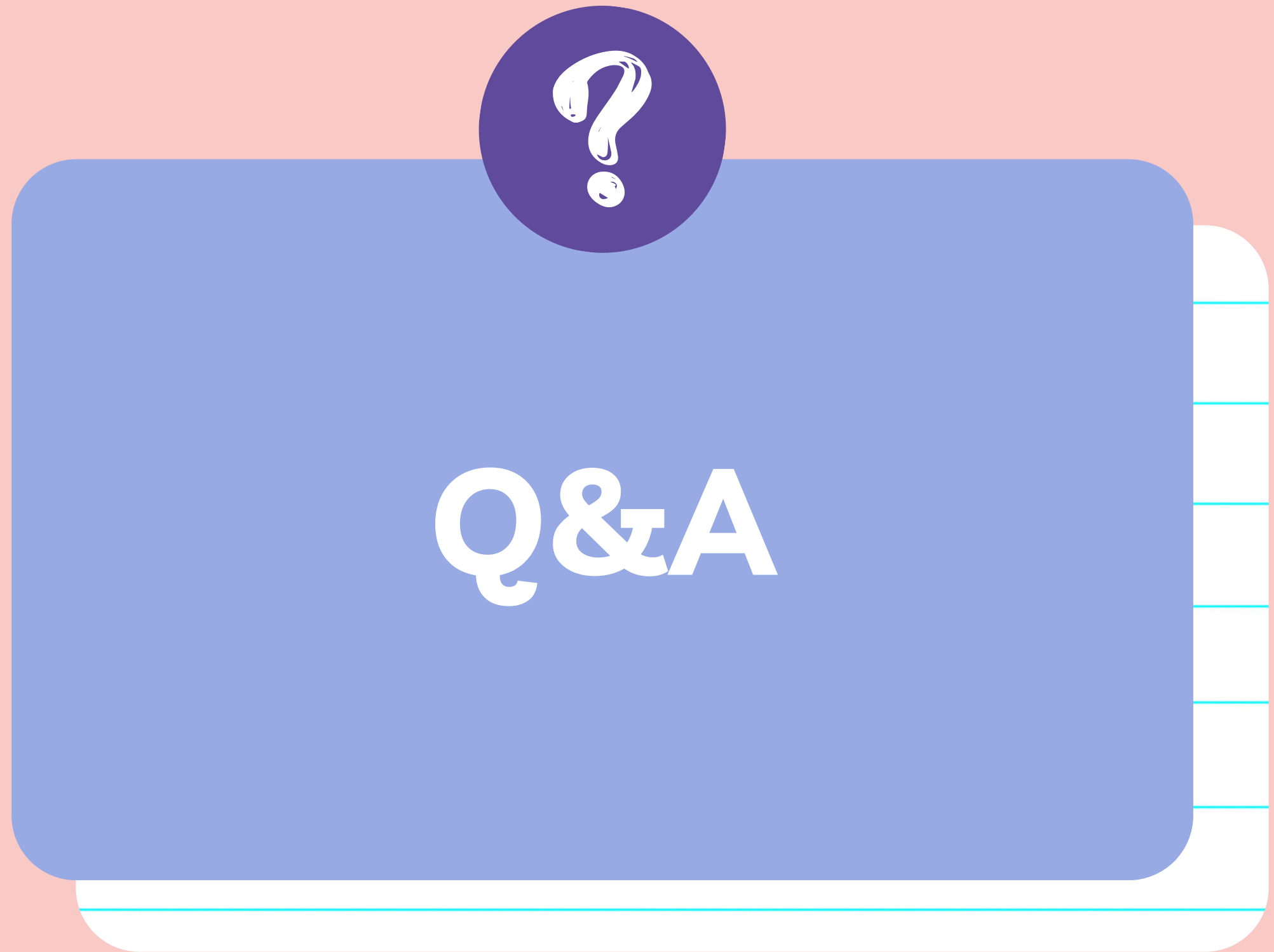
Participants dictate flow of unstructured discussion

Less stress on quality of data collected or standardization of procedures

Immerse self in the consultative process, less researcher anxiety

**Trust is key and
it goes both ways!**





Key References

TTS for Indigenous Language Education:

Pine, A., Cooper, E., Guzmán, D., Joanis, E., Kazantseva, A., Krekoski, R., Kuhn, R., Larkin, S., Littell, P., Lothian, D., Martin, A., Richmond, K., Tessier, M., Valentini-Botinhao, C., Wells, D., & Yamagishi, J. (2025). Speech generation for indigenous language education. *Computer Speech and Language*, 90, Article 101723. Advance online publication. <https://doi.org/10.1016/j.csl.2024.101723>

Ojibwe TTS Model ComputEL-6 Paper:

Hammerly, C., Fougère, S., Sierra, G., Parkhill, S., Porteous, H., & Quinn, C. (2023, March). A text-to-speech synthesis system for Border Lakes Ojibwe. In *Proceedings of the Sixth Workshop on the Use of Computational Methods in the Study of Endangered Languages* (pp. 60-65).

PD Methods:

- Barcham, M. (2023). Towards a radically inclusive design–indigenous story-telling as codesign methodology. *CoDesign*, 19(1), 1-13.
- Flaskerud, J. H., & Anderson, N. (1999). Disseminating the results of participant-focused research. *Journal of Transcultural Nursing*, 10(4), 340-349.
- Lin, P., & Van Brummelen, J. (2021, May). Engaging teachers to co-design integrated AI curriculum for K-12 classrooms. In *Proceedings of the 2021 CHI conference on human factors in computing systems* (pp. 1-12).
- Roschelle, J., Penuel, W., & Shechtman, N. (2006). Co-design of innovations with teachers: Definition and dynamics.
- Woodward, E., & Marrfurra McTaggart, P. (2016). Transforming cross-cultural water research through trust, participation and place. *Geographical Research*, 54(2), 129-142. ISO 690
- Zelenko, O., Gomez, R., & Kelly, N. (2021). Research co-design: meaningful collaboration in research. In *How to Be a design academic* (pp. 227-244). CRC Press. ISO 690

New Multilingual Ojibwe TTS Model/ FST:

- Hammerly, C., Livesay, N., Arppe, A., & Stacey, A., Silfverberg, M. (2025) OjibweMorph: An approachable finite-state transducer for Ojibwe (and beyond). Manuscript submitted for review to *Language Resources and Evaluation*.
- Wang, S., Yang, C., Parkhill, M., Quinn, C., Hammerly, C., & Zhu, J. (2025). Developing multilingual speech synthesis system for Ojibwe, Mi'kmaq, and Maliseet. arXiv preprint [arXiv:2502.02703](https://arxiv.org/abs/2502.02703).