THESIS

THE EFFECTS OF A HYBRID FLEXIBLE ESL CLASSROOM ON THE PERCEPTION AND PRODUCTION OF SEGMENTAL FEATURES OF PRONUNCIATION

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ABSTRACT

THE EFFECTS OF A HYBRID FLEXIBLE ESL CLASSROOM ON THE PERCEPTION AND PRODUCTION OF SEGMENTAL FEATURES OF PRONUNCIATION

Hybrid flexible classrooms, when employed deliberately, promise the opportunity to increase student equitable access to educational materials. This study examined changes in segmental perception and production among ESL students enrolled in a hybrid flexible course delivered across two academic terms. A communicative pronunciation curriculum designed in reference to Celce-Murcia et al. (2010) was employed. During the Fall A term, students on average improved in their perception of the /ð/ phoneme but regressed in their perception of the /θ/, /i/, /ɪ/, /u/, and /ʊ/ phonemes. During the Fall B term, students on average improved in their perception of the /ð/, /θ/, /i/, and /ɪ/ phonemes but regressed in their perception of the /u/ and /ʊ/ phonemes. Regarding isolated and sentence embedded production, Fall A students improved with /i/, maintained accuracy with /ð/ and /θ/, and regressed with /ɪ/, /u/, and /ʊ/. Fall B students improved in their isolated production of /ʊ/, maintained /ð/, and regressed with /θ/, /i/, /ɪ/, and /u/. Fall B students also improved in their sentence embedded production of /i/, /ɪ/, and /u/, maintained with /θ/, and regressed with /ð/ and /ʊ/. Also, several data sets initially planned for analysis were deemed unusable, and one third of all students originally involved in the study ultimately attritted, possibly as a result of an inability to build community while engaging with the class in the online modality. These results suggest that phoneme specific instruction varies across class

modalities. Future research should be designed with greater feasibility than was present in the current study and should more deliberately include comparison groups to increase the generalizability of claims of the efficacy of the hybrid flexible format for pronunciation instruction.

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INTRODUCTION

Hybrid flexible classrooms allow students to attend any given class session either in person or synchronously online. While these models may require significant resources, institutions with the capacity should consider adopting them because of their potential to increase equitable access to education. Along with improved access, these modalities may lead to long term financial benefits for institutions (Beatty, 2019). Although hybrid flexible classrooms are notoriously difficult to implement, they have been associated with various types of language learning outcomes, including pronunciation relevant skills.

Intelligibility is necessary for successful spoken communication between interlocutors, but explicit pronunciation instruction can often be de-emphasized in English as a Second Language (ESL) classrooms in the United States (US), even by communicatively focused programs. Hybrid flexible classrooms may increase accessibility to instruction focused on intelligible pronunciation, however, little research has explored the topic. Efficacious pronunciation instruction may be possible in such classrooms, and so could allow for ESL institutions to have broader impact on learner populations. However, research is necessary to determine specifically how the hybrid flexible format impacts pronunciation learning. This study aims to address that gap by investigating whether the hybrid flexible ESL classroom supports instruction of segmental features of pronunciation.

This study details a university level hybrid flexible ESL classroom that employed a communicative curriculum developed in reference to Celce Murcia et al. (2010) to teach segmental features of pronunciation in order to encourage intelligible spoken

English skills. Students met twice weekly for two hour sessions during the Fall semester. They participated either in person or online, synchronously via Zoom and asynchronously via WhatsApp. The classroom used cameras, microphones, a projector and screen, a dedicated whiteboard for grapheme-phoneme correspondence instruction, and a cross modality interaction station to promote speaking practice between students who attended in either format of the class. Lesson content was designed to be as contextual as possible regarding frequency of use, high functional load and prestige, and the American setting. Target phoneme segments included in lessons and analyses included /i, ɪ, ʊ, u, ð, and θ/. By analyzing student pronunciation outcomes in relation to their engagement with the hybrid flexible format, this study explores the model's potential effectiveness as a tool in pronunciation pedagogy.

A review of the relevant literature follows, along with a description of the methods, results, and implications of the study. A deliberately developed hybrid flexible ESL classroom can have positive effects on English pronunciation skills, including perception and production of segmental features.

LITERATURE REVIEW

Pronunciation Theory and Instruction

Pronunciation instruction is often underemphasized in ESL pedagogy (Park, 2015), and can be perceived as peripheral to other languages skills including grammar, vocabulary, and speaking fluency. However, a growing body of research highlights the importance of pronunciation on students' overall communicative ability, with empirical focus returning to pronunciation instruction in the 1990s (Derwing and Munro, 2015). Poor pronunciation ability can decrease second language speakers' confidence and listeners' ability to understand their interlocutor, resulting in communicative stress. The hybrid flexible environment may be able to offer ESL students great access to communicative practice opportunities, real time corrective feedback, and native and fluent speaker models, but it may also impart challenges associated with community building and digital literacy. If such digital learning environments become more common in the field of second language pedagogy, understanding how pronunciation instruction functions across each type of modality becomes more important. The following section reviews the relevant theoretical frameworks that inform the present study, in order to support a pedagogical approach that aligns appropriately with pronunciation pedagogy and the hybrid environment.

Nativeness and Intelligibility Principles

The field has historically debated what the goals of pronunciation instruction in second language classrooms should be. Levis (2005) describes two contradictory principles that have opposing pronunciation instruction goals and have influenced the field, the nativeness principle and the intelligibility principle.

The nativeness principle views native like pronunciation as both possible and desirable in second language speech, and is described by Levis (2005) as being the dominant pronunciation teaching paradigm before the 1960s. Perhaps because of the influence of research on the critical period hypothesis, that holds that there is a critical period for language acquisition that diminishes some time after puberty ends, the intelligibility principle became more popular. Levis (2005) describes the intelligibility principle as recognizing successful communication even when foreign accents are noticeable. Derwing and Munro (2015) state that, “The Intelligibility Principle… holds that the goal (of pronunciation instruction) is intelligible speech, irrespective of how native-like it sounds.” (p. 6).

Derwing and Munro (2015) suggest that productive pronunciation pedagogy should consider the influence of age, language experience, motivational influences, aptitude, and of variable instruction strategies, such as recording student utterances to allow for multiple listens, in order to raise awareness of (in)correctly pronounced texts. They claim that, “Perhaps the best promise technology offers with respect to pronunciation instruction has to do with individualized assessment and instruction…” (p. 123). The access that the hybrid flexible format offers for such individualized instruction may make it worthy of further empirical investigation. Derwing and Munro (2015) also suggest that synchronous audio software like Skype or Zoom can offer students easier access to authentic communication with other L2 learners. The suggestions were formative in the design of the present research.

Functional Load and Prestige

Intelligible communication may be a worthy goal of pronunciation instruction, but specifically which aspects of it are most relevant to the language classroom are still in question. Park (2015) highlights several key themes of effective pronunciation instruction, including explicit teaching of pronunciation rules and features, focusing attention to differences in pronounced forms between students and native-like inputs, training learners to perceive phonological distinctions before asking them to produce them, and teaching pronunciation at both the segmental and suprasegmental levels.

The present work focused on segmental pronunciation, which has been shown to be effective in imparting oral communication skills to language students (Brown, 1988; Celce-Murcia et al., 2010; Dixon et al., 2021; Gilner and Morales, 2010; Lee et al., 2015; Meritan, 2022; Olive at al., 1993; Stuart-Smith, 1999; Wang, 1967).

The concepts of prestige and functional load may offer practical guidance for selecting contextually appropriate segmentals for instruction. Prestige measures how socially desirable a given accent is, and so more appropriately aligns with the nativeness principle. Functional load measures how important a sound contrast is for understanding words in a given language, and so aligns more appropriately with the intelligibility principle. Instructors may select lesson content according to either set of concepts.

Labov (1966) explores phonological variation in New York City English and demonstrates that pronunciation patterns are socially structured and influenced by factors such as class. In 1962, Labov studied the use of the consonantal [r] in the postvocalic position of different words (like car, card, fourth, and floor) as a measure of social stratification in department stores around the city. The department stores used to

define social status (price and advertising behavior were key variables) were, from highest to lowest social class: Saks Fifth Avenue at 50th St. and 5th Ave., Macy's at 34th St. and 6th Ave., and S. Klein at 14th St. and Broadway (Labov, 1972). Labov interviewed store clerks about the locations of items known to be on the fourth floor in order to elicit the pronunciation of those words. Labov found that employees at the highest end store were more likely to pronounce postvocalic /r/ sounds than those at the middle and low end stores. Labov also found that emphatic pronunciation (formalized repetitions of fourth floor elicited when Labov pretended not to hear the clerks' first utterance) at middle and low end stores was associated with a higher likelihood to pronounce the postvocalic /r/ sounds, suggesting that people in New York City adjust their speech according to social norms and context demands.

Stuart-Smith (1999) suggested that consonant variation in Glasgow, Scotland may also be associated with social identity. The dental fricatives /θ/ and /ð/ were found to be frequently fronted to /f/ and /v/ in younger and more working class populations in the city. ESL learners may have their own perceptions of prestigious pronunciation in American English, and phonemes shown to be influenced by prestige such as /r/, /θ/, /ð/, /f/, and /v/ may be more or less applicable to these learner populations simply because of their perceptions. Considering prestige in pronunciation may be able to guide instructors on which segments to prioritize when creating curricula, and helping learners understand the sociolinguistic implications of accent variability may lead to further pronunciation learning outcomes.

Segments with a high functional load reflect a phonemic contrast that helps to distinguish between more lexical items, such as minimal pairs, in the lexicon of a given

language (Wang, 1967). Example contrasts with a high functional load in English might include /i/ vs /ɪ/ (in English *beach* and *bitch*) and /u/ vs /ʊ/ (in English *fool* and *full*). The accurate pronunciation of such words are more important to intelligibility, because they carry more informational weight. Higher functional load segments may be more appropriate targets for focused pronunciation instruction. Brown (1988) corroborates this, arguing that pronunciation syllabi should prioritize word distinctions with higher functional loads because these are more likely to affect a learner's ability to be understood in authentic communication.

Gilner and Morales (2010) provide a data driven guide for educators designing such syllabi in the American context. The authors analyzed the 10,000 most frequently used words in spoken English according to the Corpus of Contemporary American English (COCA). The researchers' aim was "to provide segmental, sequential, and syllabic level rankings of spoken English that can serve as the basis for reference and subsequent work by language educators and researchers" (p. 135). Of the 9,174,650 total word tokens analyzed by the authors, /u/ vs /ʊ/ accounted for the second highest ratio, 14.85% (589,902 tokens) of total vowel contrasts in the sample, while /i/ vs /ɪ/ accounted for the third highest ratio, 13.07% (518,996 tokens). The deliberate ESL teacher interested in pronunciation might therefore focus their curricula on words that contain these contrasts, and others (i vs eɪ, ɛ vs æ, etc.), in order to increase communicative authenticity.

Selecting segmental features most appropriate for intelligible or nativelike communication requires a balanced approach and should take learner needs and social context into consideration. The intelligibility principle suggests that instructors prioritize

phonemic contrasts with high functional load which directly impact comprehensibility of meaning. The nativeness principle might also inform the selection of segments with higher prestige, whose use has implications on the social status of the speaker. A balanced approach to effective pronunciation pedagogy should be both principled and adaptable to learner goals. This approach was taken in the selection of content used in hybrid flexible classrooms of the present study.

L1 Influence on L2 Acquisition

Acoustic phonetics, the study of the physical properties of speech sounds, can inform both language research and teaching by quantifying the differences between L1 and L2 sounds and describing how closely students are producing segments according to their instructor's models. This data can help instructors develop iterative, targeted curricula that may improve learning outcomes over time. Hybrid flexible instruction offers students the opportunity to attend class either in person or remotely, and acoustic properties in each may differ considerably. Acoustics phonetics allows instructors to offer more individualized support to learners across modalities.

MacMahon (2002) distinguishes between the defining characteristics of consonant phonemes, such as place and manner of articulation, voicing, and nasality, and those of vowel phonemes, including tongue height, frontness, lip position, length, and whether a vowel is monophthongal or diphthongal in nature. The consonant phoneme /θ/ can be described as a voiceless, oral, dental, fricative sound (and distinguishable from its "counterpart" voiced /ð/ sound), while the vowel phoneme /i/ can be described as high, front, unrounded, long, and monophthongal (and distinguishable from its "counterpart" short /ɪ/ sound). Phonemes may be differentiated using

spectrogram analysis as well. American English fricatives are “produced when the vocal tract constricts enough to cause turbulence but not enough to completely stop airflow” (Olive et al., 1993, p.92), and be can be individuated by their voicing qualities (for example, voiceless /θ/ has the lowest amount of energy of the voiceless fricatives, Olive, 1993)). Teaching metaknowledge of phonological structures like rhyme, word grasp, syllable structure, phoneme segmentation, initial and final sound identification, and sound/symbol correspondence may enhance speech comprehensibility (Gaballa, 2013), and could be mediated through spectral analysis. Designing curricula that explicitly incorporate these concepts could further support pronunciation learning.

Articulatory and acoustic properties may also play a key role in how second language learners learn new sounds. Theories on phonological processing and second language acquisition may be able to further focus pronunciation curricula employed in hybrid flexible classrooms. Best et al.’s (1988) Perceptual Assimilation Model (PAM) and Fledge’s (1995) Speech Learning Model (SLM) describe the ways in which a students’ native language (L1) affects their ability to learn the pronunciation of a second language (L2) and provide another good preliminary step as instructors design effective pronunciation activities, regardless of the classroom modality in which the are used.

Best et al., (1988) describe how L2 learners perceive unfamiliar sounds with the PAM. The PAM describes the nature of the assimilations that occur when a listener hears a second language phone that they do not know. Novel speech sounds are assimilated to previously formed categories by the listener, based on their native language (L1). The PAM outlines several different types of assimilations. In single category assimilations, both L2 sounds are mapped onto a single L1 category (e.g.

Hindi's dental /t̪/ and retroflex /ʈ/ being assimilated by a native English speaker to /t/) (Derwing and Munro, 2015). In two category assimilations, L2 sounds are perceived as mapping to two distinct L1 categories, thus making discrimination between them relatively easier. In non assimilation circumstances (e.g. a native English user listening to the Zulu palatal click /ǂ/), listeners do not perceive L2 phones as speech sounds at all, because they do not use them as components of words in their L1 (Best et al., 1988, as cited in Derwing and Munro, 2015). The PAM helps to describe the role of L1 phonology in shaping novel L2 perception.

Fledge's (1995) SLM attempts to account for how L2 learners acquire new speech sounds over time. The SLM considers the difficulties in perception that might lead to difficulties in production, and focuses on how listeners distinguish between L1 and L2 sounds (Derwing and Munro, 2015). Learners encountering an L2 sound that is similar to an L1 sound, according to the model, will have generally more difficulty with perceiving the difference between them. For example, a native Spanish user might have difficulty in perceiving the differences between the English /i/ and /ɪ/ (in English *beat* and *bit*), because Spanish only has the single high front vowel /i/ (in Spanish *sí*). A similar example is in English /u/ and /ʊ/ and Spanish /u/. These sounds are similar enough to be equivalently classified by the Spanish speaker, leading to difficulties in both distinguishing and producing the lax vowel sounds.

The PAM focuses entirely on the perception of new L2 sounds, and implies that students that cannot hear the difference between two L2 sounds will struggle to pronounce them differently. The SLM holds that speech production is secondary to perception and that it eventually "falls in line" (Derwing and Munro, 2015, p. 68), with

accurate distinctions first acquired at the perceptual level. Learners might benefit from focused training to perceive the subtle contrasts between different phonemes in order to prompt the creation of new phonetic categories not just present in their L1s. The theories imply that students should learn perception skills before they learn production, and so had implications on the present study's pedagogical design.

Ghorbani et al. (2016) corroborate the effectiveness of selective instruction of vowel perception in an Iranian EFL setting. Curricula for the experimental and control groups of students in their study only differed in that the experimental group received direct instruction of English vowel sounds that emphasized minimal pair discrimination over the duration of the study. An independent sample t-test of post test data revealed that the experimental group had significantly better vowel perception abilities, suggesting that EFL learners can benefit from direct instruction of English vowels that do not exist in Persian, such as /ɪ/, /ʌ/, and /ʊ/.

Park and Lee (2024) provide further evidence of the influence of L1 on L2 vowel acquisition by documenting a developmental trajectory in Korean ESL students' production of American English vowel sounds, "from the contrast /i/-/ɪ/ to the contrast /ɛ/-/æ/, and then the back vowel contrasts," (p. 1331). They examined the first and second formant frequencies and duration values of seven American English monophthongs. The vowels investigated by the researchers included /i, ɪ, ɛ, æ, ɔ, ʌ, and ɑ/. High proficiency ESL learners primarily relied on temporal (duration) rather than spectral characteristics (formant frequencies) while producing back vowel contrasts, while intermediate and low level learners showed no significant differences in either dimension while producing the same back vowel contrasts. Park and Lee's (2024)

findings align with the SLM and support the application of similar acoustic analyses in hybrid flexible classrooms to tailor segmental pronunciation instruction to individual learners.

Pronunciation Instruction Strategies

Colantoni et al. (2015) support the use analysis of acoustic properties that define segments, like formant frequencies for vowels and centers of gravity for fricatives, in pronunciation teaching and research. They give examples of exercises for teaching tense and lax vowel contrasts, like asking students to perceive the difference English /i/ and /ɪ/ when embedded in words. They advocate for designing curricula according to SLM and specific learner L1 contexts, and inform the design of the present study.

Celce Murcia et al. (2010) support that instructors consider the implications of the physical learning context, and that ESL contexts versus English as a Foreign Language (EFL) contexts offer different benefits and challenges to the classroom experience. ESL instructors may be able to, for example, target lax vowel phonemes like /ɪ and ʊ/ when designing curricula for Russian L1s, because their language does not contain these vowel phonemes, but may also alienate Hungarian L1s, whose language does include both these and their tense counterpart phonemes (in Hungarian *hisz*, *fut*, *hívja*, *út*, respectively), by dedicating exorbitant lesson time describing these phonemic distinctions. Instructors in such positions might be best served by curating lesson materials according to corpus based frequencies, for example.

Celce-Murcia et al. (2010) also suggest a set of digital resources for pronunciation instruction, including Audacity, a free, open source audio editing and analysis program, Praat, a program for phonetic analysis of speech through

spectrograms, pitch tracks, and formant analysis, Speech in Action, that provides model pronunciations, transcriptions, and notations regarding intonation and prominence from various English dialects, and Protea Textware, that provides example pronunciations from North American, British, and Australian speakers with varied regional accents. Informed use of such tools integrates pronunciation instruction into communicative language pedagogy relevant to hybrid flexible approaches and beyond.

There are a number of other empirical results that inform the instruction of L2 pronunciation in a variety of cultural and setting contexts. Lee et al. (2015) conducted a meta analysis to evaluate the effectiveness of L2 pronunciation instruction generally. The authors analyzed 86 primary studies conducted from 1982 to 2012 and quantified the instructional effects on L2 pronunciation learning outcomes. Lee et al. (2015) found a significant positive effect of pronunciation instruction and found instruction benefits both segmental and suprasegmental features of pronunciation. Larger effects were observed when instruction focused on segmental features of pronunciation, suggesting further exigence for the investigation of the influence of teaching such features in hybrid flexible formats. Lee et al. (2015) recommend that future research includes the fine grained analysis of the effects of different types of pedagogical practices on pronunciation learning that the present study aims to address.

This review examines the importance of theoretical frameworks, empirical research, and instructional strategies relevant to segmental pronunciation instruction in hybrid flexible ESL classrooms. Goals of intelligible or native like English pronunciation are motivated by different factors like sociolinguistic implications and the need to express meaning. Acoustic phonetics has a role in informing research paradigms and

differentiated instruction according to context. Spectral analysis software may allow for more nuanced descriptions of L1 and L2 sound systems and developmental trajectories, and these sets of metaknowledge may even support students' communicative fluency. Segmental pronunciation instruction is also heavily influenced by the specific technologies employed in a typical hybrid flexible classroom. A review of the major developments in educational technology leading to the use of hybrid flexible formats to teach language, as well as how these developments inform the present research, follows.

Technology and Language Learning

Technology has become increasingly central to enhanced language education, and several pedagogical models have been developed to guide the effective implementation of technology. The following section reviews several such pedagogical frameworks in order to briefly describe the historical development of the hybrid flexible modality and motivate its use in the present research.

Foundational Models

Mishra and Koeler (2006) introduce their Technological Pedagogical Content Knowledge (TPACK) framework, a model that builds upon Shulman's (1986) concept of pedagogical content knowledge by integrating technology as a key component of effective teaching. Their work emphasizes that teaching with technology is not simply about adding digital tools to previously established curricula and lesson plans, but about reconfiguring those pedagogical strategies according to the new possibilities afforded by technology. At the intersection of all three subsets of knowledge is TPACK, the optimal combinatorial use of each, or the "basis of good teaching with technology (that) requires

an understanding of the representation of concepts (being taught) usings technologies…" (p. 1029). The authors suggest that good teaching should consider each of these subsets of knowledge as interdependent, and that comprehensive instruction using technology considers the interplay of each. Mishra and Koehler (2006) advocate for an interdisciplinary approach to future teacher training that fosters the growth of TPACK knowledge.

Puentedura (2025) offers a similar digital teaching framework to understand different levels of technology use in the classroom, the Substitution, Augmentation, Modification, Redefinition (SAMR) framework. The SAMR model became a popular guiding frame for institutions using technology enhanced instruction, and has been recommended as an approach for developing hybrid flexible courses (Petryk and Kosharna, 2023). Hamilton et al. (2016) provides a critical review of the SAMR model, particularly that it lacks contextual flexibility, is too rigid in its structure, is too focused on final instructional products over more process oriented approaches, and should be seen as a reflective tool rather than a prescriptive one. Hamilton et al. (2016) suggest that teachers be flexible in their employment of technology according to their contextual and student needs. The authors emphasize that teachers should continue to consider the contextual knowledge subset present in the TPACK framework from Mishra and Koheler (2006). Hamilton et al. (2016) also say, "contrary to what is implied by the SAMR model, we suggest that technology integration is neither an educational goal nor is it sufficient on its own to enhance learning outcomes." Teachers employing a hybrid or hybrid flexible classroom model with a great deal of technology should not take positive

learning outcomes for granted, and should remain deliberate in its execution to ensure that learning continues to occur.

Ma et al. (2024) expand the TPACK framework by exploring its application to corpus technology integration in Teaching English as a Second or Other Language (TESOL) preparatory classrooms. Their study introduces Corpus Based Language Pedagogy (CBLP), which represents the intersection of the TPACK with the use of corpus tools like the COCA. CBLP is described as “the ability to use the technology of corpus linguistics to facilitate language teaching in a classroom context” (Ma et al. 2022, p. 2372, as cited by Ma et al., 2024). Ma et al. (2024 also investigate the effects of collaboration on the development of CBLP materials. In their study, 33 pre-service TESOL teachers enrolled in a graduate level vocabulary learning and teaching course in a Chinese setting took part in a 4 week CBLP training program. They found that intragroup collaboration supported student’s comprehension and curriculum transformation processes, while intergroup collaboration promoted more sophistical pedagogical applications of the corpus tools. Ma et al. (2024) encourage pre-service ESL instructors to design instructional materials that integrate copus technology to enhance both linguistic content and pedagogical strategies. Their work directly addresses the contextualization concerns outlined by Hamilton et al. (2016), improving both the TPACK and SAMR models, and offering guidance for designing student interactions in the present research.

Hybrid Instruction

Garrison and Vaughan (2008) offer a comprehensive text on the practical application of hybrid learning in higher education. Hybrid learning, often termed blended

learning by the field, embraces the use of more traditional in person teaching strategies and online learning tools at the same time. Online tools might be synchronous or asynchronous in nature, and the field does use both the hybrid and blended terms for both cases at times, but for the purposes of the present study, just asynchronous applications of online learning tools will be considered first. The Community of Inquiry framework (CoI) is central to the text and emphasizes three interdependent elements necessary for meaningful learning: cognitive presence, social presence, and teaching presence (Garrison et al., 1999). Garrison and Vaughan (2008) argue for fostering these presences in hybrid formats in order to increase student centricity, and for pedagogical strategies that integrate technology while preserving the benefits of in person interaction.

Harrington (2010) further critiques the assumption that the hybrid learning environment is inherently beneficial to ESL/EFL students. Harrington (2010) describes the switching from in person to online formats as resulting in an incomplete identity, an “instructional schizophrenia” that alienates ESL/EFL students from both subcommunities and negatively affects student perceptions of interactions. The author presents several considerations for hybrid instructors of ESL/EFL classrooms to help curb this concern, including making certain that students have access to the online technology that defines the classroom, monitoring the participation of students in the online portion of the class in particular, eliminating inactive and non participatory roles in discussion activities, proactively establishing a list of rules for online discussion collaboratively with students, and giving students the opportunity to choose one on one tutoring in person at institutions whenever possible. Harrington’s (2010) work gives a

new set of suggestions focused on improving community engagement among students in these classes.

Cautionary tales against poorly implemented hybrid models do not diminish their potential to improve language learning outcomes in ESL/EFL classrooms. Yang and Spitzer (2020) provide a positive case for using hybrid learning to teach academic reading in Mongolia. Their class of international students at an Intensive English Program (IEP) met face to face twice weekly, while also participating in a third asynchronous online session. Data came from student interviews, follow up questionnaires, and classroom observations. The researchers found that students were initially unfamiliar with hybrid model classrooms, they recognized that the method has some advantages over traditional models, they did not feel extra burden related to technological demands, and they felt different levels of comfort according to language skills being learned. The authors emphasize communication as key to learning, reiterating Harrington (2010), and conclude that their hybrid model was effective and well received.

Torabi (2024) further supports the efficacy potential of hybrid model classrooms for teaching EFL learners pragmatic awareness in an Iranian context. This study involved 90 intermediate level female learners divided into groups receiving flipped instruction, described by Torabi as “a type of blended teaching in which learners are first exposed to the lesson outside of class via online presentation…” (p. 132), blended instruction with a modified asynchronous component, and traditional face to face instruction. One way ANOVA testing of a discourse completion test revealed that both the flipped and blended learning environments significantly improved students ability to

perform apology and request speech acts (the traditional format did not result in the same learning outcomes), and that the two teaching modalities did not significantly differ from one another. The work by Torabi (2024) suggests that blended learning can effectively enhance pragmatic competence in EFL contexts.

Dixon et al. (2021) provide a meta-analysis of 11 total primary studies conducted from 2000 to 2021 that highlights the positive effects of hybrid language instruction. Their analysis showed a moderate overall positive effect in favor of hybrid formats compared to traditional face to face instruction, with different language skills being more or less amenable to a reduction in face to face instruction time in favor of online materials delivery. Specifically, writing courses seem to receive greater benefits from transitions to hybrid instruction, and conversation skills courses seem to receive lesser benefits from those transitions. The authors state that, “a course whose primary focus is on the development of conversational skills could benefit from a lesser reduction in (face to face) time, as the development of conversational skills requires co-construction of meaning and turn taking in real time.” (p. 804). Conversation skills might include segmental features of pronunciation, and so a hybrid flexible classroom aimed at developing such feature skills should prioritize curricula that allow for as many opportunities for co-construction of meaning as possible. We believe that a well designed communicative pedagogical framework may be able to provide these opportunities.

Hybrid learning has been associated with many positive learning outcomes in language classrooms, including increased pragmatic competence, academic reading ability, and writing ability. However, the design of a hybrid classroom should be

contextually sensitive, allow for rich interactions, and value community building among all students whenever possible. The hybrid flexible format employed in the present study aims to address several of these concerns.

Hybrid Flexible Instruction

Beatty (2019) provides guidance on the implementation of student centered hybrid flexible classrooms. Hybrid flexible course designs, often termed hyflex by the field, are different from hybrid/blended learning environments in that they allow students to join either in person or online synchronously using digital meetings platforms like Zoom, Google Meets, or Microsoft Teams, while usually hybrid modalities imply asynchronous online interactions between students. Beatty (2019) provides a general introduction to the format, including descriptions of hybrid flexible course designs that support student directed learning, the implementation of hybrid flexible instruction, and a brief summary of various hybrid flexible classrooms currently employed around the world.

Beatty (2019) also summarizes some of the major costs and benefits associated with hybrid flexible courses and programs. The potential costs to students associated with adoption of the class format include more demanding time management, stress associated with personal agency in learning, and decision making costs. For teachers, the modality has higher resource demands and workloads. Administrations face increased budget demands, as teachers need additional training and technical resources like computers, cameras, microphones, speakers, and software. The potential benefits associated with adoption of the class format include increased access to course (when attendance in class in person or online is problematic for students),

more robust instructional materials that allow for richer learning opportunities, the ability to serve more students than traditional or online only formats might afford, and increased enrollment sizes for programs overall. Beatty (2019) doesn't outright advocate for blind implementation of hybrid flexible courses, but suggests that programs investigate the possible positive impacts that such courses might have for their students.

Detyna et al. (2023) explore some of the practical challenges and opportunities with implementing the hybrid flexible teaching format in a higher education setting. The work summarizes the creation of a hybrid flexible classroom format in the summer of 2020 at King's College in London in response to the COVID-19 pandemic. Some of the principal findings of their research is that the modality increased cognitive and workload demands on instructors, imparted inequities in engagement opportunities between in person and remote learners, and challenged both populations with a learning curve related to digital tool management in real time. Despite these issues, the authors suggest that the hybrid flexible model can offer benefits, including attendance flexibility, increased student autonomy, and broader access to learning. Detyna et al. (2023) remind administrators of the importance of institutional support and professional development in order to make such classroom models successful.

Raes et al. (2020) provide a meta-analysis of 47 primary research studies investigating the benefits, challenges, and design principles of synchronous hybrid learning (hybrid flexible learning) conducted from 2003 to 2019. The key benefits of hybrid flexible learning outlined by the authors include organizational benefits, including the potential to reach a greater base of potential students, the possibility to offer more

elective or specific courses than traditional format offerings might allow for, the elimination of the need to teach two versions of the same course online and in person (a potential solution to the associated resource demands imparted by the format), and increased freedom and flexibility for secondary jobs and family commitments from both the student and teacher perspectives. The pedagogical benefits associated with hybrid flexible classrooms include the possibility to include expert influence from outside of the hosting institution, increased social benefits from greater exposure to new contacts throughout the world, higher learning opportunities to under-represented students, the ability to offer students a great sense of long term control in their learning, and the increased opportunity to teach digital literacy skills that can later be transferred to students' future careers.

Ulla and Espique (2022) describe a perspective of university teachers in Thailand when implementing the hybrid flexible classroom format. The authors frame the shift towards more hybrid classrooms in Thailand as a result of the COVID-19 pandemic, which originally motivated FRCC's shift to offering the hybrid flexible classroom experience in the present study. All teachers interviewed in their study used Zoom and synchronous online class teaching to run hybrid flexible classrooms. Teachers reported that hybrid flexible classrooms made themselves and students excited to return to physical learning spaces, and that they felt that hybrid flexible teaching gave them extra stress and anxiety, with some teachers even claiming that they would not want to teach another hybrid flexible class again. One teacher wrote that a challenge specific to the model was how and where to write language examples. Another wrote that conducting both formative and summative assessments was challenging in the format. Still, Ulla

and Espique (2022) point out that teachers recognized the importance of hybrid flexible instruction to give students greater opportunities to learn. Hybrid flexible classrooms are contextually sensitive, and remain productive only when specific contextual demands are at the forefront of teacher and administrator curriculum planning.

Digital, blended, and hybrid flexible classrooms in particular, require proactive and empirically based designs to be effective. Students, teachers, and administrators should not consider increased language learning outcomes given after implementing or taking part in a hybrid flexible classroom. However, research does suggest that successful implementations of the model are possible. In order to further establish what leads to successful implementation of the model for pronunciation learning in ESL classrooms, several tools and techniques associated with hybrid flexible pronunciation instruction, as well as higher order, empirically backed hybrid flexible pronunciation pedagogical suggestions will be further reviewed.

Hybrid Flexible Pronunciation Instruction

To this point, research has suggested the importance of the strategic selection of pronunciation skills worthy of teaching according to the surrounding context, and that the hybrid flexible model can be beneficial with deliberate implementation informed by the needs of the students, instructors, and administrators of a given institutional setting. Beneficial segmental pronunciation may be possible in hybrid flexible classrooms. The specific tools, techniques, and broader pedagogical strategies that could be used in such a course have received some empirical attention, and help to inform the present study.

Tools and Techniques

There are a number of different tools and associated techniques that have been used in language classes in an effort to increase pronunciation learning outcomes. The following section details research on various researcher developed computer and phone applications used to provide automated or exaggerated corrective feedback, as well as on the implementation of WhatsApp and Zoom to support segmental pronunciation and natural oral communication skills. Not all of the following tools are used in hybrid flexible formats specifically, but the combined pedagogical insights afforded by these studies have implications for the design of the hybrid flexible format employed in the present study.

Synchronous online interaction with a phone application's corrective feedback may function to support segmental and suprasegmental pronunciation in English for Specific Purposes (ESP) in the Iranian context (Aghaei et al., 2022). 60 undergraduate students enrolled in an ESP course on guidance and counseling were divided into a control group who received feedback from a lecturer on segmental pronunciation, word stress, intonation, and rhythm accuracy, and an experimental group, who received feedback from a synchronous software application designed by the researchers to give the same type of pronunciation feedback during class in real time. Data showed that synchronous use of the application led to significantly greater development of word stress, intonation, and segmental pronunciation (Aghaei et al., 2022). The authors do not further detail their developed pronunciation application, but the article suggests that phone applications used synchronously online in otherwise pure in person classrooms may be an effective way to provide corrective pronunciation feedback, at least in an EFL setting.

Wang et al. (2024) used digital zoom technology to visually reinforce facial movements while producing consonantal segments (including the trill /r/, the postvocalic /l/, and the dental fricatives /θ/ and /ð/, because of their more observable articulatory gestures) for Chinese L1s learning Spanish as a foreign language in a Chinese setting. In the experimental group, instructors used tablets to provide magnified visual demonstrations of the articulatory gestures associated with each target segment, while students used smartphones with similar digital zoom capabilities for self monitoring. The control group received only traditional analytic-linguistic instruction for explicit instruction and an audio only intuitive-imitative approach for students' practice. The experimental group showed significant improvement in producing the postvocalic /l/ and both dental fricatives /θ/ and /ð/. Students also reported generally positive attitudes towards the visual reinforcement training. Importantly, both the control and experimental groups were instructed in an in person class, but the research does suggest that this type of technology may be useful in improving foreign language segmental instruction. This software may feasibly be implemented in online format classes as well, suggesting that it could be useful in hybrid flexible formats.

A study of 34 English L1 students learning German as an L2 in an online asynchronous undergraduate course found that an internally developed computer assisted method of pronunciation instruction was useful in teaching both perception and production of pronunciation at both the word and sentence levels (Martin, 2020). The pronunciation targets assessed in the study included allophones of /r/: consonantal [ʁ] and vocalic [ɐ], [ç] and [x], [e:], [o:], [y:], [ø:], various orthographic-phoneme correspondences, and lexical stress in German-English cognates. The specific method

of computer assisted pronunciation employed in this study was called innovative Cued Pronunciation Readings (iCPR), based on Tanner and Landon's (2009) Cued Pronunciation Readings. Students in the control group did not engage with the targeted pronunciation training provided by iCPR. Results showed significant improvements in accentedness detection and sound discrimination tasks (perception tasks), and significant improvements in word level and paragraph level (production tasks). Exit questionnaires also suggested that students felt positively about the iCPR instructional tool. Though this study was conducted only in an online asynchronous class, it does suggest that computer aided, targeted pronunciation training can have a positive effect on learning segmental features of pronunciation, and similar cued dialogue activities were used in the present study.

Andújar-Vaca and Cruz-Martínez (2017) describe productive pronunciation instruction through group interactions via WhatsApp for Spanish L1s learning English in a Spanish university context. The authors attempted to increase the amount of authentic language interactions possible in the experimental group using students' cellphones. Students studying EFL at an intermediate level were instructed to only communicate in the WhatsApp class group in oral English. Students posed and responded to daily questions and were encouraged to self correct or reformulate their spoken English according to peer reactions, encouraging natural negotiation of meaning. The researchers analyzed these spoken interactions and found that episodes of negotiation of meaning triggered by mispronunciations at the word level decreased over time, suggesting that these students were learning pronunciation naturally. Students in the experimental group performed significantly higher on pronunciation post tests of oral

proficiency than did students in the control group as well. These researchers suggest that WhatsApp, a tool commonly used by ESL students in the American context (and employed in the current study), can be an effective instructional tool when employed asynchronously online in pronunciation classrooms.

Meritan (2022) showed that online pronunciation instruction can potentially foster the acquisition of segmental production skills in French. 10 Students of various L1s enrolled in a university level, intermediate French as a second language course in a French setting took part in the study. Six of the 10 students attended in person in the classroom, and four attended synchronously via Zoom. Importantly, the course was not the same type of hybrid flexible model employed in the present study, because students were asked to commit to their format choice for the entirety of the semester (the format employed by Meritan (2022) was termed a blended synchronous learning model (BSLM) according to previous work by Hastie et al., 2010). Explicit pronunciation instruction was delivered via an online learning platform to all students in the form of spelling to sound video lessons on French final consonants, nasal vowels, oral vowels, semivowels, mandatory and forbidden liaisons, and the schwa. Online and face to face pronunciation instruction did not result in different production learning outcomes, suggesting that the particular BSLM model employed in this research may be an effective substitute for traditional face to face classes.

De Nicolás Saiz and Sande Piñeiro (2022) further explore the use of Zoom and other video conferencing platforms, as well as other online teaching tools, in order to effectively teach speaking skills in Spanish as a foreign language classrooms. The authors first outline a set of challenges associated with using Zoom in such a way,

including a loss of paralinguistic cues of student engagement, fewer opportunities for student interactions, and higher anxiety in students that are participating in an online versus an in person class. The authors then explain a series of specific practical strategies that enhance oral interaction in online settings, including using breakout rooms to pair students randomly or selectively and to allow or disallow groups of students to be in rooms privately, and using the share screen function in combination with other online learning tools like Flipgrid, Jamboard, Padlet, or Google Docs to facilitate active learning in unique ways. De Nicolás Saiz and Sande Piñeiro (2022) claim that online teaching is “here to stay” (p. 56), and advocate for more focused research in the use of such video conferencing platforms to improve our understanding of their efficient use in language classrooms. Hybrid flexible classrooms are currently largely dependent on the use of these platforms (Beatty, 2019), and so should be included in this future research.

The research summarized above shows that various mobile and computer assisted technologies can improve segmental pronunciation through feedback, modeling, and interactive practice. WhatsApp and Zoom in particular were both used in the present study in an effort to provide real time and asynchronous opportunities for spoken language practice for students, regardless of the modality in which they preferred to attend the class.

Hybrid Flexible Pronunciation Pedagogy

Oliwa (2024) provides one framework for the practical application of language hybrid flexible classrooms. He suggests that appropriate interaction between a learning management system (LMS) (e.g. Moodle, Google Classroom, Office 365, Canvas, etc.)

progress assessment resources (built in tools that LMSs offer like comments on Google Docs), and content presentation tools (e.g. Youtube, Canva, Prezi, Edpuzzle, etc.) can define success in these modalities. Pronunciation teachers might consider at this level which LMS, which progress assessment tools, and which content delivery resources allow for the greatest amount of input of target phonemes. In the current study, WhatsApp and Zoom were used as LMSs (Zoom also doubled as a presentation tool), audio recording as a progress assessment tool, and Google Slides as a primary content presentation tool. Oliwa (2024) concludes by calling for more specific research into successful implementation and for scaling of the model in tertiary contexts.

Kosharna et al. (2023) recommend careful planning to ensure that both in person and online participants in a language classroom receive equivalent learning experiences. Simple pronunciation games like fly swatter, in which students, armed with the game's namesake, listen for the model pronunciation of minimal pairs written on the board to then smack, are anecdotally engaging in more traditional settings, but may not be adaptable to hybrid flexible formats without serious design changes. Such design choices reflect a procedural component that is important to consider for every single activity planned for use in a pronunciation hybrid flexible class.

Sheerah and Yadav (2022) delivered a 13 week hybrid flexible EFL course at the university level in Saudi Arabia and measured students' perceptions on the model's ability to help them learn speaking skills. The study incorporated podcasts and TED Talks as asynchronous materials, synchronous virtual classroom sessions conducted via Blackboard for interactive speaking practice, and a traditional class setting. Sheerah and Yadav (2022) found that students felt that the class model was effective in

improving their speaking abilities, felt more confident when speaking, and appreciated the added schedule flexibility offered. The authors suggest that such perceived improvements in speaking abilities may be due to the hybrid flexible format's ability to provide multiple modes of feedback.

Importantly, student engagement within a hybrid flexible ESL classroom can be quantified in a number of ways. Nurharjanto (2023) distinguishes between cognitive (what students think during lessons), behavioral (what students do during lessons), and affective (how students feel during lessons) engagement in hybrid English classrooms. Engagement itself is described by Nurharjanto (2023) as a dynamic and multidimensional construct that can be quantified using observations, surveys, or mixed methods approaches. The present study defines student engagement in the hybrid flexible ESL classroom simply as attendance, but more nuanced measurements of engagement are likely necessary for a more specific understanding of students' perception of and engagement with the modality.

Pronunciation instruction in hybrid flexible classrooms requires careful tool choice and activity design, as well as equal access to community and speaking opportunities. Lesson content should be selected as specifically as possible to improve student intelligibility. Activities in hybrid flexible classrooms may need significant redesign or may even need to be abandoned. Hardware and software used in these classes may offer benefits or impart additional challenges depending on student and teacher digital literacy levels. The hybrid flexible classroom environment is very complex, but its focused implementation can promote inclusive access to education materials (Öz, 2024). The present study aims to address a research gap in hybrid flexible ESL

pronunciation instruction in an effort to further improve equitable access to education.

RESEARCH QUESTIONS

The current study is embedded both in the fields of pronunciation and hybrid flexible design research. It aims to selectively curate a set of segmental features of pronunciation that are contextually sensitive and empirically supported and offer as rich and empirically backed a hybrid flexible format as possible to provide for increased learner intelligibility. To better understand the efficacy of employing the hybrid flexible class format for ESL pronunciation instruction, this study aims to respond to two primary research questions:

1. How does a hybrid flexible ESL classroom environment impact students' perception and production of specific segmental features of pronunciation?
2. Which segmental features of pronunciation show the greatest improvement in perception and production accuracy across different instructional modes?

METHODS

Setting

Hybrid flexible non credit ESL classes are taught at FRCC's Boulder County Campus in Longmont, Colorado and Westminster Campus in Westminster, Colorado. FRCC offers various levels and modalities of classes in the ESL program, and follows specific learning outcomes that are collaboratively (re)designed with the instructors in the program, their lead instructors, and the department chair once annually. Curricula employed in the program are also collaboratively developed, though instructors do have notable agency in developing learning materials, so long as they follow the program's communicative philosophical approach. High basic courses tend to offer English materials at a roughly A1 to A2 CEFR level, intermediate courses at roughly a B1 level, and advanced at a roughly B2 level, though levels are defined primarily by their student populations, and so can differ slightly from one semester to the next. FRCC currently employs the communicative approach to language instruction, defined by Celce-Murcia et. al (2010) as instruction that allows students to develop communicative competence, helping learners to be intelligible and comprehensible in real world communication. The class in which this research occurred was labeled by FRCC as an intermediate level Communication and Reading and Writing for Success course, lasted two hours per lesson, and met twice a week for fifteen weeks. A summary of the ESL competencies expected of students upon completion of FRCC's intermediate level course is provided as Table 1 below.

High basic and intermediate level ESL courses at FRCC are offered in half terms throughout three semesters, with seven and a half week terms offered during the Fall

and Spring semesters, and four week terms in the Summer semester. These splits are primarily offered to increase student equity; students are allowed to pay their registration fees over two installments and can add and drop courses with more flexibility because of these splits. Advanced level ESL courses are also offered as 15 week semester long courses. The numbers of each of these class levels and modalities offered at FRCC differ from term to term based on student demand and instructor expertise, though FRCC does tend towards offering at least one of each level of course. The total population of ESL students at FRCC during the Fall 2024 semester was roughly 60 students per the ESL Lead Instructor and Bilingual Enrollment Specialist, Francis Schneeweiss.

Table 1: *Summarized FRCC ESL Competencies for Intermediate Level Courses*

ESL Competencies	Learning Goals
An ELL can construct meaning from oral presentations, conversations, literary stories, and informational text by listening, reading, and viewing.	Determine a central idea or theme in oral presentations and written texts. Participate in conversations and written exchanges.
An ELL can explain the meaning of words and phrases in oral presentations, conversations, literary, and informational text.	Explain meaning of general academic and content specific words and phrases. Identify context clues to decipher meaning.
An ELL can analyze and critique the arguments of others orally and in writing and share findings or solve problems.	Understand and discuss a claim with scaffolding. Explain their ideas and personal views.
An ELL can speak and write about level appropriate literary and informational texts and topics.	Share short oral presentations. Write complete sentences/paragraphs. Identify correct grammar to convey ideas.
An ELL can create clear and coherent level appropriate speech and written text.	Retell events with a beginning, middle, and end, and include transitional words.
An ELL can participate in level appropriate oral conversations.	Participate in conversations about familiar topics and academic content.

Students are not offered formal grades in these non credit ESL classes. Instead, they are asked to self select their most appropriate class based on a number of factors including their schedule constraints, their preferred teaching modality (in person, online, or hybrid flexible), their preferred teacher, and their proficiency level. Instructors in the program do recommend levels to individual students on a case by case basis, and reiterate these recommendations as the students progress within the program. Students can “graduate” the program into credit bearing English courses designed to serve non native English speaking populations and students that have never taken college level English courses before taking their first native English college composition course. The ESL program at FRCC has a main goal of producing students capable of productive and receptive use of English at the college level, so that they are ready for professional and academic settings that use English every day.

The classroom used at FRCC has six large student tables, each offering four seats and spread out evenly throughout the space. The classroom also has a teacher desk with a computer, an OWL camera, microphone, and speaker, and a projector managing device. There is also a read aloud desk, where students are asked to sit during read aloud activities so that students attending online can properly hear their peers. There is also a projector and screen that is used to display lesson Google Slides and various online supplementary materials. This projector screen was always the shared screen in the Zoom version of the class, unless a specific activity demanded otherwise. A whiteboard was also present in the classroom and was used primarily to write student contributions to the class activities in real time. The OWL camera was

fixed on the entire classroom, so that students attending online could see their entire class of peers attending in person. A cell phone connected to the Zoom class using the instructor's mobile internet data (an important step in case the campus internet malfunctioned) was fixed on the whiteboard and muted, to allow students in Zoom the ability to see what was being written on the board, while also not interfering with the classroom's audio set up (the general class microphone and speaker was provided by the OWL device). Finally, a cross modality interaction station was set up on one of the student tables, to allow students the ability to interact with their peers across the in person and online formats of the class. This station has a computer that was always in a breakout room in the Zoom classroom to avoid audio interference, and when necessary, students in person were asked to sit at the station to work with students that the instructor assigned to that same breakout room. A diagram of the classroom used throughout the study is provided as Figure 1 below.

Participants

15 total non credit ESL students attending FRCC participated in the research study. 6 student participants were omitted from perception task data analyses, and 8 were omitted from production task data analyses; These participants' data were omitted because they were not complete, meaning that the student did not complete both a pre and post test. Mid 1 and 2 tests were conducted, but their data was entirely omitted from analyses because many students did not complete these tests. The participant data included in the perception analyses (n = 9) ranged in age from 22 to 46 years old, with a mean age of 31.8 years (SD = 10.14). The participant data included in the production analyses (n = 5) ranged in age from 22 to 44, with a mean age of 32 years

(SD = 12). Student participants whose data were included in the analyses were from Colombia, Russia, France, Brazil, Peru, Mexico, and Thailand.

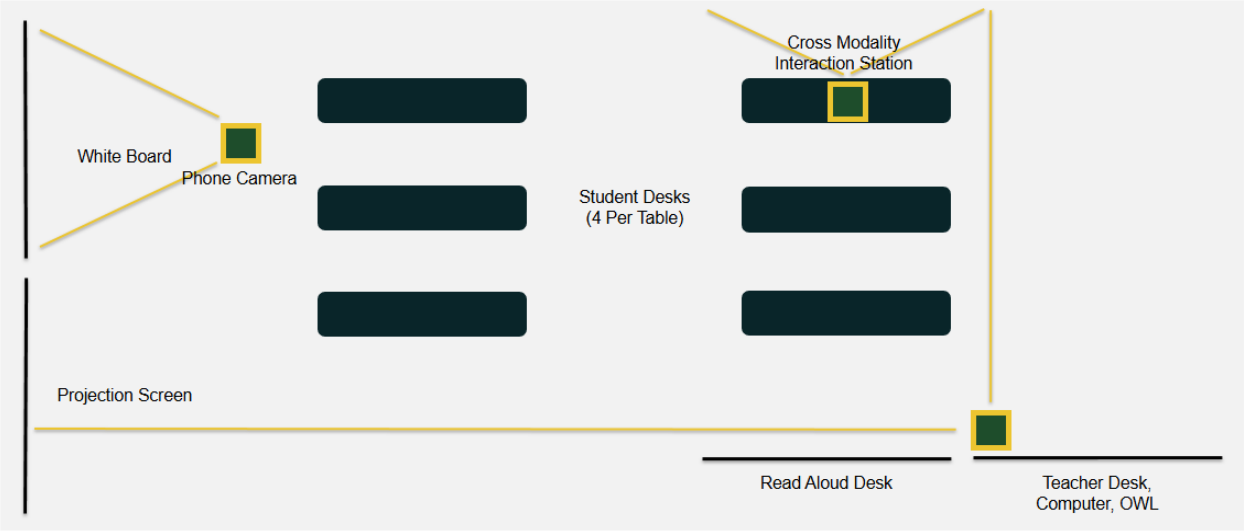

Figure 1: *Diagram of Classroom Used in Study*

Note: Squares with borders denote the major computing devices used during lessons. Solid lines from each denote the areas captured by each device's camera.

Student participants analyzed had an average of 25.2 months of formal (inside of a classroom) English instruction (SD = 39.4), and an average of 34.6 months of informal (outside of a classroom) English instruction (SD = 104.7). Participants' level of education ranged from completion of middle school to master's degree level. Participants' native languages included Portugues, Russian, Spanish, French, and Thai, and two students claimed some level of fluency in an additional language (in Spanish and Portuguese). Participants lived in the U.S. for an average of 55.5 months (SD = 79.5) prior to the study, and none had lived in the U.S. before the study. All student participants provided informed consent before the experiment began and were debriefed on the details of the study after their participation, as required by the university's Institutional Review Board (IRB). No participant received payment or course

credit for their participation in the study; participants that elected to not take part in the study were allowed to participate in the class to the same degree as any other student was. The IRB protocol number associated with the study is IRB #5768, and an example blank consent form is provided as appendix A below. Student demographic data for all students included in analyses are provided as appendix B below.

Lesson Materials

The selection of the materials to be taught and tested in the present study were largely based on their relevance to ELLs in an ESL setting, and this relevance was instantiated in several different ways. The phoneme segments chosen for the study were based on their relatively high level of either functional load or prestige. The vowel phonemes /i, ɪ, ʊ, and u/ were selected because of their relatively high functional loads (Wang, 1967; Brown, 1988). The dental fricative phonemes /ð/ and /θ/ were selected because of their relatively high prestige (Labov, 1966; Stuart-Smith, 1999).

The words which contained the above segments were chosen from the COCA (Davies, 2025) based on several selection criteria. In general, words were selected from most frequently used in the corpus to least frequently used until each target phoneme word set was completed, in order to keep lesson/test materials as relevant to students in the American ESL context as possible. 24 total words containing each of the six target phonemes were selected, for a total of 144 words. Each target word was only included once in the lesson/test materials (no word was counted as containing more than one target phoneme). Words that met each of the following inclusion criteria were chosen to be taught and tested until that target phoneme category had a total of 24

usable words. Words were associated with categories in a random order, one category at a time. Words were excluded from use in the study if they:

1. Did not have the (vowel) target phoneme in the stressed syllable of the word. This was justified because of vowel reduction, which makes vowels reduce, losing their quality and becoming more schwa like (McMahon, 2002). Consonant segments didn't adhere to this criterion because they are not subject to the same type of pronunciation reduction.
2. Were not considered a lemma by the COCA. Non lemmas were avoided in order to ignore the influence of inflectional variability on pronunciation.
3. Had a homophone with a more frequently used word in the COCA. This was justified because of the possibility of lexical level confounding our analyses because of frequency effects.

Importantly, the words "simply" and "history" were originally defined as containing the target phoneme /ɪ/, but were removed from data analysis because they also contain the other phoneme relevant to their teaching pair, /i/. Lists of each word containing the target phonemes /ð/, /θ/, /i/, /ɪ/, /u/, and /ʊ/ that were used in the study are provided below in appendices C through H, respectively.

Distractor words were selected for use in the study in a similar way, and were only excluded from use in the study if they were already in use elsewhere in the lesson/test materials. Each distractor word used in the materials were selected from most to least frequently used in the corpus, until 24 total distractors were identified. A list of the distractors used in the study is provided below as appendix I.

All target phoneme containing words and distractor words were randomly associated with use in either the A or B term of the Fall 2024 semester at FRCC. Each lesson and test was designed with random order as well. The phonemes were taught three times each throughout each term in the broader Fall semester, with each word being taught once per term. Each lesson contained four words containing two target phonemes each, for a total of eight target phonemes/words per class meeting. The randomly selected teaching order for the Fall A term was /ð/ and /θ/, then /u/ and /ʊ/, then /i/ and /ɪ/ for lessons 3-5, /i/ and /ɪ/, then /ð/ and /θ/, then /u/ and /ʊ/ for lessons 7-9, and finally /u/ and /ʊ/, then /ð/ and /θ/, then /i/ and /ɪ/ for lessons 11-13, respectively. The randomly selected teaching order for the Fall B term was /u/ and /ʊ/, then /ð/ and /θ/, then /i/ and /ɪ/ for lessons 3-5, /i/ and /ɪ/, then /u/ and /ʊ/, then /ð/ and /θ/ for lessons 7-9, and finally /u/ and /ʊ/, then /i/ and /ɪ/, then /ð/ and /θ/ for lessons 11-13, respectively. An example lesson that further contextualizes the design of the broader curriculum is provided below as appendix J.

Activities associated with pronunciation instruction were delivered during the first half of each class throughout the Fall 2024 terms A and B at FRCC. The pronunciation lessons were designed according to Celce-Murcia et al.'s *Teaching pronunciation: A course book and reference guide* (2010). Page 45 of the book provides a summarization of a pronunciation curriculum the authors recommend that fits into an ESL curriculum focused on fostering communicative competence in its students. A recreation of that table is displayed as Table 2 below. FRCC provides a communicative ESL curriculum and expects this type of curriculum from its instructors, and so the lesson unity design outlined by Celce-Murcia et al. (2010) was deemed most relevant to the hosting

program, and so also to its student participants in the study. The curriculum also allowed for both perception and production tasks throughout lessons and tests, which are important in second language speech acquisition (Derwing and Munro, 2015).

Table 2: *Celce-Murcia et al.'s (2010) Communicative Framework for Teaching Pronunciation*

1	**Description and Analysis** - Oral and written illustrations of how the feature is produced and when it occurs within spoken discourse
2	**Listening Discrimination** - Focused listening practice with feedback on learners' ability to correctly discriminate the feature.
3	**Controlled Practice** - Oral reading of minimal pair sentences, short dialogues, etc., with special attention paid to the highlighted feature in order to raise learner consciousness.
4	**Guided Practice** - Structured communication exercises, such as information gap activities or cued dialogues, that enable the learner to monitor for the specific feature.
5	**Communicative Practice** - Less structured, fluency building activities (e.g. role play, problem solving) that require the learner to attend both form and content of utterances

Testing Materials

Students' ability to perceive and produce the target segments was measured using a set of a pre, two mid, and a post test per term. Each test included a single perception task and two production tasks. The order of presentations for each group of segment words (and distractors, when applicable) was randomly selected for each task present in the tests. Six of the 12 total words associated with each term that contained target phonemes (2 from each lesson) were randomly selected and included as the tested phonemes. In the perception task, students were asked to listen to words pronounced by the instructor and distinguish between phonemes that could be present

in the word. In the first production task, students were asked to read the words that contained the target segments among a set of distractor words. In the second, students were asked to read the same words embedded in sentences. No distractor words/sentences were present in the second production task.

Sentences present in the second production task were designed specifically to always contain the subject pronoun “I” at the beginning of the sentence in order to place target words/phonemes into the sentence focus position as often as possible, to reduce the possibility for vowel reduction (MacMahon, 2002). These sentences also always used the word containing the target phoneme in the same part of speech as was associated with the word in the COCA. Whenever possible, target words were used in either the main verb or direct or indirect object position in the sentence. This was to ensure that target words were in sentence focus positions, to further reduce the possibility for vowel reduction (MacMahon, 2002). Sentences were also written in subject, verb, object order whenever possible. Each test sentence was from three to six words long.

In each of the production tasks, student participants were instructed to read a word/sentence silently to themselves first, and then to look at the tester and say the word/sentence before moving on in an effort to reduce the reading effect’s influence on pronunciation variability present in the data collected. Spoken intonation was prioritized whenever possible in order to mimic natural speech. Words containing target phonemes were also presented in bolded face in order to further decrease the chance of vowel reduction. The order in which the words and sentences associated with each subtest were randomized. Only students who followed each of the instructions above were

included in production analyses. Examples of a pre test, two mid tests, and a post test, each that were used in the Fall B term, are provided as appendices K through N below, respectively.

Apparatus

Computer assisted language learning defines the hybrid flexible approach, but the specific instantiation of computer hardware and software of a hybrid flexible ESL classroom is not currently standardized in the field. The specific hardware and software employed by the hybrid flexible ESL classroom in the present study are detailed below.

During lessons, a Dell Optiplex SFF 7010 desktop computer with a Dell P2418HT 23.8” monitor, a SONY Crestron VPL-PHZ10 projector, a Lenovo t14 Gen 5s laptop computer, a Samsung Galaxy S10e SM-G970U cellphone, and an Owl Meeting Labs Owl Pro 3 MTW 300-1000 camera, microphone, and speaker were used. Speaker volume and microphone sensitivity remained constant throughout the term. Zoom version 6.4.6 for Windows was used to host the online class format. WhatsApp versions 2.24.17.20 - 2.24.25.78 for Android and iOS mobile devices were used for whole class communications both during and outside of class. Windows 10 was used for all computers, and Android 15 was used for the class cellphone. The cellphone was placed roughly 48 inches from the whiteboard, and the cross modality interaction laptop roughly 24 inches from in person students while in use. Google Slides was used to display lesson materials.

During testing, students went to a neighboring classroom to record production data on a Dell Optiplex SFF 7010 desktop computer with a Dell P2418HT 23.8” monitor and a FIFINE K669 USB microphone. Zoom was used to record student production data

if students attended online during a testing period, and an online voice recording tool[1] was used to record student production data if students attended in person during a testing period. Students sat roughly 24 inches from the monitor screen and 6 inches from the microphone when recording production data in person. Praat version 6.4.27 was used for all production data analyses. Google Docs was used to display testing materials. Google Sheets was used for data recording, and Jeffery's Amazing Statistics Program (JASP) version 0.14.3 was used for data analysis (JASP Team, 2025). Photos contextualizing the physical classroom and various apparatus are provided as appendix O below.

Lesson Procedures

Student participants in the study attended 15 total class sessions. During class one, students participated in an introduction activity, read and signed consent forms, and completed demographic surveys. During classes 2, 6, 10, and 14 students completed the pre, mid 1, mid 2, and post tests respectively. During classes 3-5, 7-9, and 11-13 students received direct instruction for each of the target phonemes, with one pair of phonemes (/i/ and /ɪ/, /ʊ/ and /u/, and /ð/ and /θ/) taught during each lesson. Each pronunciation lesson lasted roughly one hour each. During the second half of the class, students were given supplementary instruction. During the second half of class in the Fall A term, students learned American history through mini lectures, vocabulary exercises, and video reviews, and during the second half of class in the Fall B term, students learned verb tenses and sentence and paragraph writing. During class 15, students were presented with completion certificates, completed informal reflection

[1] The online voice recording tool used in the study can be found at https://online-voice-recorder.com.

activities, and provided make up post tests if necessary. An example of each term's sequence is provided as Figure 2 below, and an example of each lesson's sequence is provided as Figure 3 below.

Testing Procedures

Perception and production pronunciation testing occurred during lessons, 2, 6, 10, and 14. During the perception subtest, all students numbered paper from 1 through 12 and were instructed to listen to a word pronounced by the instructor, and write the number 1 if they heard a given phoneme in the pair (e.g. /ð/ and /θ/), and the number 2 if they heard the other phoneme in the pair. The instructor pronounced each word in the perception task twice, then moved on to the next word in the list, and offered students the opportunity to ask for additional model pronunciations if necessary at the end of the test. Students taking the test in person gave their answers to the perception task to the instructor physically, and students taking the test online gave their answers to the perception task by taking a photo of their answers and sending it to the instructor via WhatsApp. Perception testing took about 15 minutes during each testing day.

Introductory Day
Pre Test
Pronunciation Lesson 1
Pronunciation Lesson 2
Pronunciation Lesson 3
Mid 1 Test
Pronunciation Lesson 4
Pronunciation Lesson 5
Pronunciation Lesson 6

Mid 2 Test
Pronunciation Lesson 7
Pronunciation Lesson 8
Pronunciation Lesson 9
Post Test
Conclusion Day

Figure 2: *Term Sequence*

During the production subtests, students attending in person went to a neighboring classroom individually to reduce classroom noise. Students were presented with the test items on a desktop computer screen, one subtest at a time (first production test one, then production test two). Students completed production test one by reading aloud 36 words containing target phonemes and 12 distractor words into a desktop microphone. Students completed production test two by reading aloud 36 simple sentences containing target words/phonemes in sentence focus positions whenever possible. Students attending online were moved individually to a breakout room

Introduction/Agenda
Pronunciation: Description and Analysis
Pronunciation: Listening Discrimination
Pronunciation: Controlled Practice
Pronunciation: Guided Practice
Pronunciation: Communicative Practice
Break
Supplementary Instruction

Figure 3: *Lesson Sequence*

dedicated only to testing and recording data, and the instructor moved to the same neighboring classroom to conduct the test. Students not currently taking a production subtest were led through ice breaker activities by substitute FRCC instructors in the main classroom. Production testing took about 10 minutes for each student during each testing day. An example of each testing sequence is provided as Figure 4 below.

Perception Subtest (Whole Class)
Production Subtest 1 (Individually)
Production Subtest 2 (Individually)

Figure 4: *Testing Sequence*

Data Processing

Perception data was recorded into Google Sheets and analyzed using Jeffery's Amazing Statistics Program (JASP), a free, open source software maintained by the University of Amsterdam and used for statistical analysis (JASP Team, 2025). Production data was recorded as a mp3 file if students attended in person, and as a m4a file if students attended online, and were converted to wav files for use in Praat using an online file conversion tool[2]. Production data was analyzed using Praat, a free, open source software used for analyzing speech in phonetics and other linguistics research (Boersma and Weenink, 2025). Each target phoneme in all relevant student data was first identified based on their acoustic properties in Praat, with visual inspection of each target word's spectrogram as well as auditory inspection. For vowel

[2] The file conversion tool tool used in the study can be found at https://https://cloudconvert.com.

phonemes, the first two formants' midpoint frequencies were measured using an automated Praat script then recorded into Google Sheets for each utterance (Styler and Scarborough, 2016). For the dental fricative phonemes, productions were judged audio-visually to be present or absent by a researcher. Data from Praat of an example student production of the target word "father" (containing the target phoneme /ð/) judged as absent is compared to the same word produced by the instructor and judged as present in Figure 5 below. Student production data were compared to their instructor at FRCC to gauge learning outcomes.

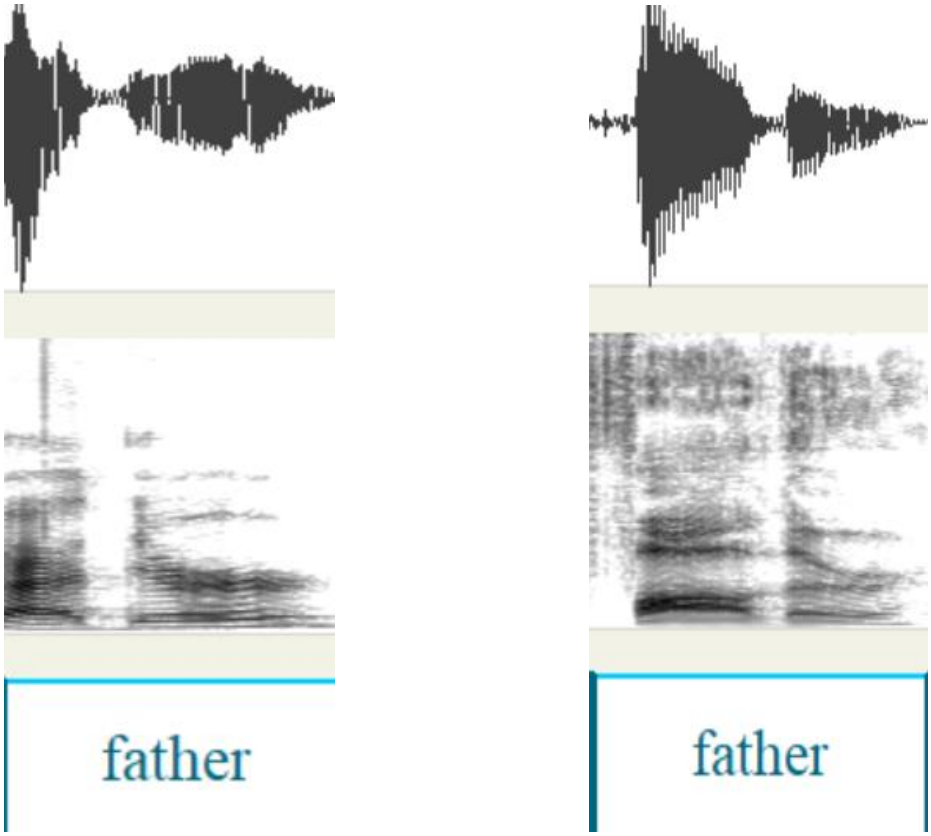

Figure 5: *Student 6 and Instructor "Father" Productions in Praat*

Note: Student 6 production of the isolated /ð/ is on the left and was judged as absent. Instructor production of the same isolated /ð/ is on the right and was judged as present.

RESULTS

Analysis

Small sample sizes and inconsistencies in the data limit the strength and generalizability of findings. Several of our data sets were incomplete, leading to our making the decision to focus analyses on students who provided only completed pre and post tests. There was also general low engagement with the synchronous online version of the class, some attrition, and some students did not participate in all assessments or participated inappropriately for various possible reasons. Given these issues, statistical analyses were deemed inappropriate. Instead, descriptive statistics and student case studies will be presented below to illustrate individual learning trajectories and their relationships to the hybrid flexible format.

Perception Results

Perception ability was measured with a single phoneme discrimination task. Summaries of the descriptive statistics for all students in the Fall A (n = 6) and Fall B (n = 3) terms are provided below as Table 3 (pre test), Table 4 (post test), Table 5 (pre test), and Table 6 (post test), respectively. Students in the Fall A term on average improved in their perception of the /ð/ phoneme, and regressed in their their perception of the /θ/, /i/, /ɪ/, /u/, and /ʊ/ phonemes. Students in the Fall B term on average improved in their perception of the /ð/, /θ/, /i/, and /ɪ/ phonemes, and regressed in their perception of the /u/ and /ʊ/ phonemes.

Table 3: *Fall A Perception Pre Test Descriptive Statistics*

Phoneme	$\bar{x}$	SD	min	max
/ð/	4	1.89	2	6

/θ/	4	1.54	1	5
/i/	5.16	0.75	4	6
/ɪ/	4.5	1.22	3	6
/u/	3.67	0.81	3	5
/ʊ/	3.83	1.47	2	5

Table 4: *Fall A Perception Post Test Descriptive Statistics*

Phoneme	x̄	SD	min	max
/ð/	4.33	1.63	2	6
/θ/	4.16	1.47	3	6
/i/	4.83	1.16	3	6
/ɪ/	3.5	1.51	1	5
/u/	3.33	1.21	2	5
/ʊ/	3.16	1.6	2	6

Table 5: *Fall B Perception Pre Test Descriptive Statistics*

Phoneme	x̄	SD	min	max
/ð/	3.33	2.88	0	5
/θ/	4	3.46	0	6
/i/	5.33	0.57	5	6
/ɪ/	3.33	0.57	3	4
/u/	5.33	0.57	5	6
/ʊ/	4.33	1.15	3	5

Table 6: *Fall B Perception Post Test Descriptive Statistics*

Phoneme	x̄	SD	min	max
/ð/	4.67	1.52	3	6
/θ/	5	1.73	3	6
/i/	5.67	0.57	5	6
/ɪ/	5	1	4	6
/u/	3.33	3.05	0	6
/ʊ/	3.33	3.05	0	6

Perception graphs for each relevant student are provided below as appendix P. An example perception graph displays student 7's perception learning outcomes and is provided as Figure 6 below. Perception graphs display student performance on a pre and post phoneme perception task across six target phonemes. The y axis shows the number of correct phoneme perceptions out of 6 total possible. A note above the chart gives modality attendance context for each student. 15 total lessons, including introduction, testing, and conclusion days, are depicted in these notes.

Student 7 seems to have generally benefited from segmental pronunciation instruction, particularly for the /ɪ/ and /ʊ/ phonemes. She was well engaged in the in person format of the class, providing a complete data set, including both mid tests, only missing two of 15 class periods, and attending entirely in person. This student's data was chosen for display here to emphasize the perception learning outcomes possible from the pronunciation instruction used in the present hybrid flexible classroom design.

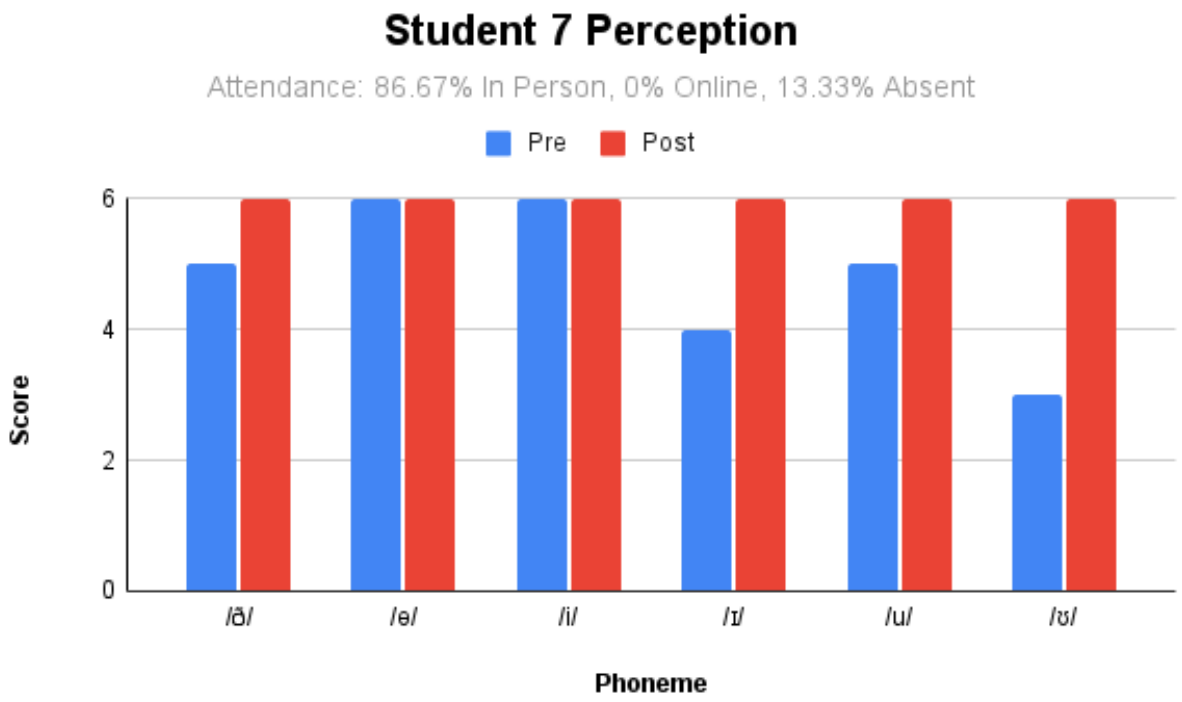

Figure 6: *Student 7 Perception Results*

Production Results

Production ability was measured with two different tasks, one that asked students to read target phonemes embedded in isolated words (labeled production 1 in the example tests in the appendices), and another that asked students to read target phonemes embedded in those same words in simple sentences (labeled production 2 in the example tests in the appendices). Summaries of the descriptive statistics for all students in the Fall A (n = 3) term included in the isolated vowel production analysis are provided below as Table 7 (pre test) and Table 8 (post test) below. Compared to an L1 English speaker referent, students in the Fall A term on average improved in their isolated production the of /i/ phoneme, because this phoneme moved closer towards the model, and regressed in their isolated production of phonemes /ɪ/, /u/, and /ʊ/ because these phonemes moved further away. Differences in frequencies for each phoneme in

the first and second formants were treated as having equivalent weight. The relevant English L1 reference frequencies are displayed as Table 9 below.

Table 7: *Fall A Isolated Vowel Pre Test Descriptive Statistics*

Phoneme	Formant	x̄	SD	min	max
/i/	1	454.27 Hz	94.1	379.14 Hz	559.83 Hz
/i/	2	2068.28 Hz	594.3	1393 Hz	2511.74 Hz
/ɪ/	1	475.32 Hz	115.93	382.2 Hz	605.16 Hz
/ɪ/	2	2038.44 Hz	438.84	1535.33 Hz	2342.4 Hz
/u/	1	491.43 Hz	135.34	380.33 Hz	642.16 Hz
/u/	2	1631.52 Hz	380	1208 Hz	1944.16 Hz
/ʊ/	1	485.28 Hz	54.68	423.16 Hz	526.16 Hz
/ʊ/	2	1138.83 Hz	188.14	1025.16 Hz	1356 Hz

Table 8: *Fall A Isolated Vowel Post Test Descriptive Statistics*

Phoneme	Formant	x̄	SD	min	max
/i/	1	352.51 Hz	38.53	309.71 Hz	384.42 Hz
/i/	2	2535.71 Hz	351	2219.57 Hz	2913.42 Hz
/ɪ/	1	418.53 Hz	90.52	351 Hz	521.4 Hz
/ɪ/	2	2214.64 Hz	375.55	1784 Hz	2474.14
/u/	1	399.67 Hz	34.64	360 Hz	424 Hz
/u/	2	1075.77 Hz	171.31	878.16 Hz	1182.5 Hz
/ʊ/	1	419.05 Hz	51.7	360	456.16 Hz
/ʊ/	2	926.77 Hz	88.85	824.67	986.5 Hz

Table 9: *Fall A English L1 Isolated Vowel Reference Values*

Phoneme	Formant	Frequency
/i/	1	295 Hz
/i/	2	2412.14 Hz
/ɪ/	1	402.8 Hz
/ɪ/	2	1978.8 Hz
/u/	1	421 Hz
/u/	2	1570.16 Hz
/ʊ/	1	507.5 Hz
/ʊ/	2	1159 Hz

Summaries of the descriptive statistics for all students in the Fall B (n = 2) term included in the isolated vowel production analysis are provided below as Table 10 (pre test) and Table 11 (post test). Compared to an L1 English speaker referent, students in the Fall B term on average improved in their isolated production of the /ʊ/ phoneme, because this phoneme moved closer towards the model, and regressed in their isolated production of phonemes /i/, /ɪ/,and /u/, because these phonemes moved further away. Differences in frequencies for each phoneme in the first and second formants were treated as having equivalent weight. The relevant English L1 reference frequencies are displayed as Table 12 below.

Table 10: *Fall B Isolated Vowel Pre Test Descriptive Statistics*

Phoneme	Formant	$\bar{x}$	SD	min	max
/i/	1	338.24 Hz	76.48	284.16 Hz	392.33 Hz
/i/	2	2430.58 Hz	52.91	2393.16 Hz	2468 Hz
/ɪ/	1	364.16 Hz	19.32	350.5 Hz	377.83 Hz

/ɪ/	2	2371.58 Hz	197.39	2232 Hz	2511.16 Hz
/u/	1	369.89 Hz	18.93	356.5 Hz	383.28 Hz
/u/	2	1477.77 Hz	9.81	1470.83 Hz	1484.71 Hz
/ʊ/	1	404.83 Hz	21.44	389.67 Hz	420 Hz
/ʊ/	2	1218.66 HZ	139.53	1120 Hz	1317.33 Hz

Table 11: *Fall B Isolated Vowel Post Test Descriptive Statistics*

Phoneme	Formant	$\bar{x}$	SD	min	max
/i/	1	374.78 Hz	8.18	369 Hz	380.57 Hz
/i/	2	2395.78 Hz	25.15	2378 Hz	2413.57 Hz
/ɪ/	1	359.4 Hz	43.55	328.6 Hz	390.2 Hz
/ɪ/	2	2451.7 Hz	0.42	2451.4 Hz	2452 Hz
/u/	1	349.95 Hz	55.79	310.5 Hz	389.4 Hz
/u/	2	1413.03 Hz	23.51	1396.4 Hz	1429.66 Hz
/ʊ/	1	439.24 Hz	51.73	402.66 Hz	475.83 Hz
/ʊ/	2	1266.33 Hz	165.22	1149.5 Hz	1383.16 Hz

Table 12: *Fall B English L1 Isolated Vowel Reference Values*

Phoneme	Formant	Frequency
/i/	1	309.16 Hz
/i/	2	2459 Hz
/ɪ/	1	461.67 Hz
/ɪ/	2	1785.33 Hz
/u/	1	289 Hz
/u/	2	1571.67 Hz

/ʊ/	1	452.33 Hz
/ʊ/	2	1276.33 Hz

Summaries of the descriptive statistics for all students in the Fall A (n = 3) term included in the isolated consonant analysis are provided below as Table 13 (pre test) and Table 14 (post test). Compared to an L1 English speaker referent with scores of /ð/ of 4 and /θ/ of 6, students in the Fall A term on average maintained their ability to produce the /ð/ and /θ/ phonemes in isolation.

Table 13: *Fall A Isolated Consonant Pre Test Descriptive Statistics*

Phoneme	$\bar{x}$	SD	min	max
/ð/	2	2.64	0	5
/θ/	3	2	1	3

Table 14: *Fall A Isolated Consonant Post Test Descriptive Statistics*

Phoneme	$\bar{x}$	SD	min	max
/ð/	2	3.46	0	6
/θ/	3	2.64	0	5

Summaries of the descriptive statistics for all students in the Fall B (n = 2) term included in the isolated consonant analysis are provided below as Table 15 (pre test) and Table 16 (post test). Compared to a native English referent with scores of /ð/ of 4 and /θ/ of 6, students in the Fall B term on average maintained their ability to produce the /ð/ phoneme in isolation, and regressed in their ability to produce /θ/ phoneme in isolation.

Table 15: *Fall B Isolated Consonant Pre Test Descriptive Statistics*

Phoneme	$\bar{x}$	SD	min	max
/ð/	3.5	0.7	3	4
/θ/	6	0	6	6

Table 16: *Fall B Isolated Consonant Post Test Descriptive Statistics*

Phoneme	$\bar{x}$	SD	min	max
/ð/	3.5	2.12	2	5
/θ/	4.5	0.7	4	5

Vowel and consonant isolated word production graphs for each relevant student are provided below as appendices Q and R, respectively. Example vowel and consonant isolated production graphs are provided below as Figures 7 and 8, respectively. A note above each vowel and consonant isolated word graph gives modality attendance context for each student, similarly to the perception charts.

Vowel isolated word graphs are formant graphs that display student performance on an isolated word production task across six phonemes. The y axis shows the first formant value, corresponding to vowel height, and the x axis shows the second formant value, corresponding to vowel frontness. A high front vowel (e.g. /i/) will be represented on the top left of the graph, and a high back vowel (e.g. /u/) will be represented on the top right of the graph.

Student 2 seems to have improve their ability to pronounce the phonemes /i/, /ɪ/, and /u/ in isolation when compared to a native English referent, which is represented by the post test entries in the graph moving closer to the reference entry. Student 2 still

seems to struggle to differentiate between the tense and lax /u/ and /ʊ/ phonemes. They may need further support with /ʊ/ to maintain intelligibility in contrasts with /u/. This student's graph was chosen for display to exemplify how to read each formant plot.

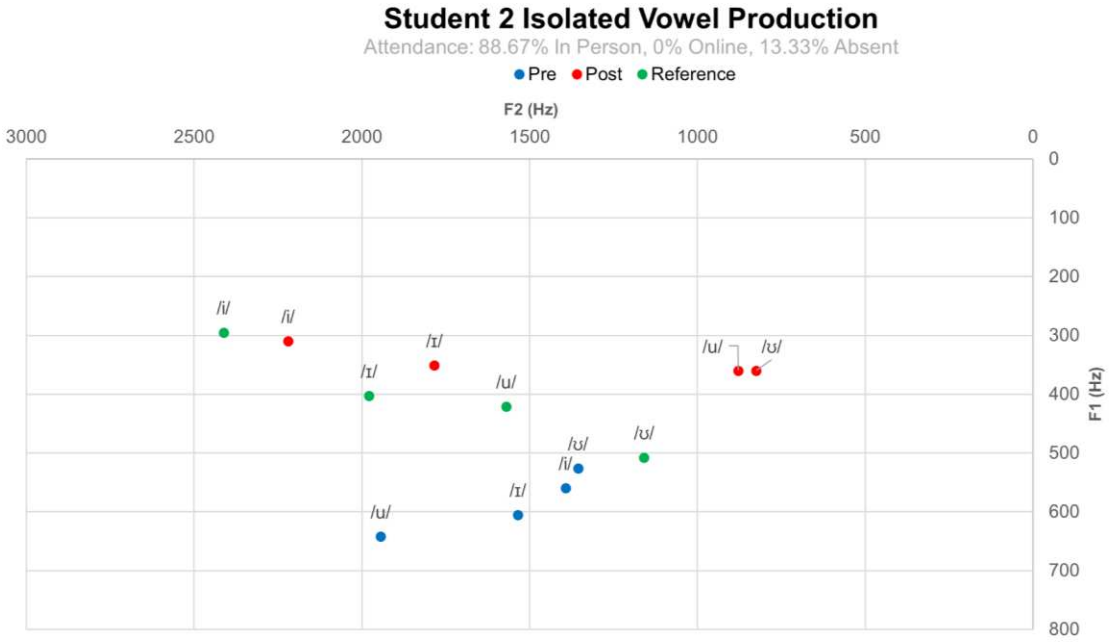

Figure 7: *Student 2 Isolated Vowel Production*

Student 4 attended relatively infrequently, and slightly preferred online participation. Compared to a native English referent, this student seems to have slightly regressed in their ability to pronounce the /ð/ phoneme in isolation from the beginning to the end of class, though their ability to pronounce the /θ/ seems to have slightly increased. This student's graph was chosen for display to highlight the potential for a lack of attendance to impact production ability learning outcomes.

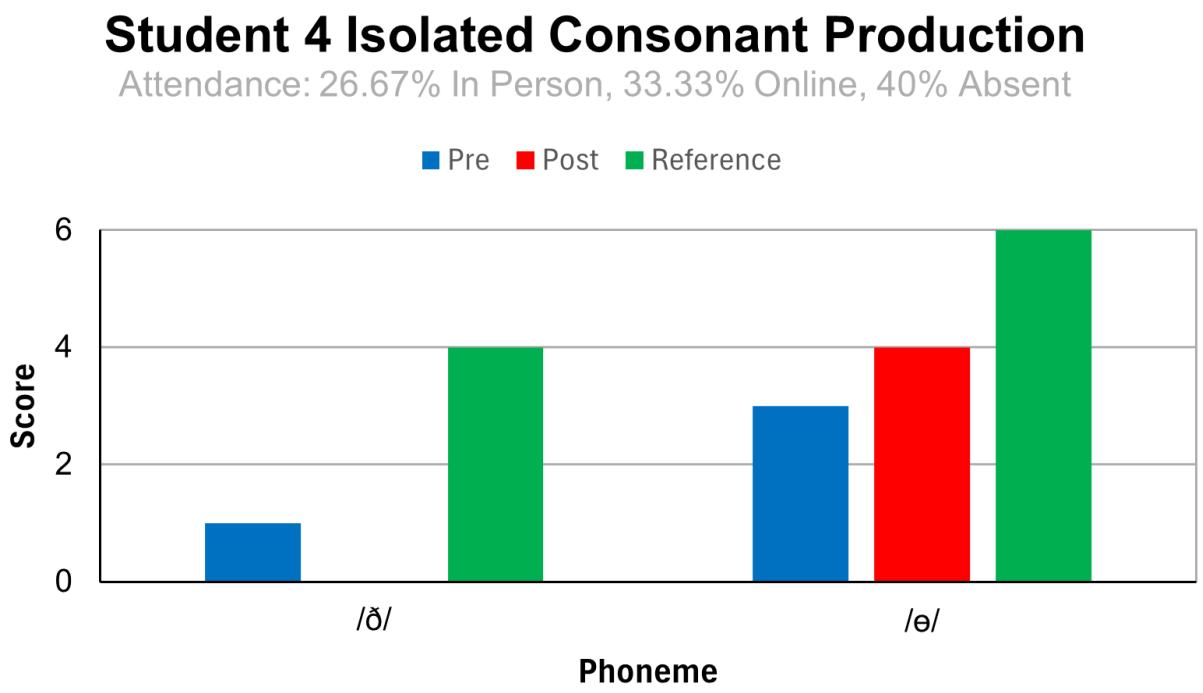

Figure 8: *Student 4 Isolated Consonant Production*

Summaries of the descriptive statistics for all students in the Fall A (n = 3) term included in the sentence embedded vowel production analysis are provided below as Table 17 (pre test) and Table 18 (post test). Compared to an L1 English speaker referent, students in the Fall A term on average improved in their sentence embedded production of the /i/ phoneme, because this phoneme moved closer towards the English model, and regressed in their embedded production of phonemes /ɪ/, /u/, and /ʊ/, because these phonemes moved further away. Differences in frequencies for each phoneme in the first and second formants were treated as having equivalent weight. The relevant English L1 frequencies are displayed below as Table 19.

Table 17: *Fall A Sentence Embedded Vowel Pre Test Descriptive Statistics*

Phoneme	Formant	x̄	SD	min	max

/i/	1	426.85 Hz	45.65	382.85 Hz	474 Hz
/i/	2	2006.64 Hz	661.47	1234.5 Hz	2415.85 Hz
/ɪ/	1	461.65 Hz	38.92	423.16 Hz	501 Hz
/ɪ/	2	2083.65 Hz	442.4	1575.57 Hz	2383.6 Hz
/u/	1	557.22 Hz	191.86	423.16 Hz	777 Hz
/u/	2	1386.44 Hz	372.9	1166.16 Hz	1817 Hz
/ʊ/	1	487.81 Hz	79.54	434.833 Hz	579.28 Hz
/ʊ/	2	1216.06 Hz	302.93	1038.83 Hz	1565.85 Hz

Table 18: *Fall A Sentence Embedded Vowel Post Test Descriptive Statistics*

Phoneme	Formant	$\bar{x}$	SD	min	max
/i/	1	349.13 Hz	27.51	321.83 Hz	376.85 Hz
/i/	2	2445.15 Hz	215.23	2209.33 Hz	2631 Hz
/ɪ/	1	498.01 Hz	137.85	386.8 Hz	652.25 Hz
/ɪ/	2	2078.2 Hz	273.88	1767 Hz	2282.6 Hz
/u/	1	397.62 Hz	61.27	327 Hz	436.67 Hz
/u/	2	1095.35 Hz	116.47	987.2 Hz	1218.67Hz
/ʊ/	1	401.86 Hz	38.13	358 Hz	427.16 Hz
/ʊ/	2	956.04 Hz	82.47	889 Hz	1048.14 Hz

Table 19: *Fall A English L1 Sentence Embedded Vowel Reference Values*

Phoneme	Formant	Frequency
/i/	1	307.71 Hz
/i/	2	2399 Hz
/ɪ/	1	393.6 Hz

/ɪ/	2	1999.6 Hz
/u/	1	309.33 Hz
/u/	2	1518 Hz
/ʊ/	1	486 Hz
/ʊ/	2	1207.33 Hz

Summaries of the descriptive statistics for all students in the Fall B (n = 2) term included in the sentence embedded production analysis are provided below as Table 20 (pre test) and Table 21 (post test). Compared to an L1 English speaker referent, students in the Fall B term on average improved in their sentence embedded production of /i/, /ɪ/, and /u/ phonemes, because these phonemes moved closer towards the English model, and regressed in their embedded production of the phoneme /ʊ/, because this phoneme moved further away.Differences in frequencies for each phoneme in the first and second formants were treated as having equivalent weight. The relevant English L1 reference frequencies are displayed as Table 22 below.

Table 20: *Fall B Sentence Embedded Vowel Pre Test Descriptive Statistics*

Phoneme	Formant	$\bar{x}$	SD	min	max
/i/	1	396.41 Hz	36.64	370.5 Hz	422.33 Hz
/i/	2	2344.74 Hz	43.01	2314.33 Hz	2375.16 Hz
/ɪ/	1	363.08 Hz	36.88	337 Hz	389.16 Hz
/ɪ/	2	2488.38 Hz	128.38	2397.6 Hz	2579.16 Hz
/u/	1	360.74 Hz	47.25	327.33 Hz	394.16 Hz
/u/	2	1618.91 Hz	10.25	1611.66 Hz	1626.16 Hz
/ʊ/	1	405.91 Hz	10.96	398.16 Hz	413.66 Hz

/ʊ/	2	1359.41 Hz	114.67	1278.33 Hz	1440.5 Hz

Table 21: *Fall B Sentence Embedded Vowel Post Test Descriptive Statistics*

Phoneme	Formant	x̄	SD	min	max
/i/	1	370.41 Hz	22.5	354.5 Hz	386.33 Hz
/i/	2	2379.25 Hz	95.1	2312 Hz	2446.5 Hz
/ɪ/	1	353.49 Hz	33.7	329.66 Hz	377.33 Hz
/ɪ/	2	2344.83 Hz	48.08	2310.83 Hz	2378.83 Hz
/u/	1	357.33 Hz	52.32	320.33 Hz	394.33Hz
/u/	2	1523.16 Hz	36.29	1497.5 Hz	1548.83 Hz
/ʊ/	1	472.58 Hz	17.56	460.16 Hz	485 Hz
/ʊ/	2	1375.66 Hz	73.3	1323.83 Hz	1427.5 Hz

Table 22: *Fall B English L1 Sentence Embedded Vowel Reference Values*

Phoneme	Formant	Frequency
/i/	1	299.33 Hz
/i/	2	2459 Hz
/ɪ/	1	436.33 Hz
/ɪ/	2	1776.67 Hz
/u/	1	294.83 Hz
/u/	2	1538.5 Hz
/ʊ/	1	412.83 Hz
/ʊ/	2	1250.33 Hz

Summaries of the descriptive statistics for all students in the Fall A (n = 3) term included in the sentence embedded consonant analysis are provided below as Table 23 (pre test) and Table 24 (post test). Compared to an L1 English speaker referent with scores of /ð/ of 3 and /θ/ of 6, students in the Fall A term on average maintained their ability to produce the /ð/ and /θ/ phonemes when embedded in sentences.

Table 23: *Fall A Sentence Embedded Consonant Pre Test Descriptive Statistics*

Phoneme	$\bar{x}$	SD	min	max
/ð/	1.67	2.88	0	5
/θ/	2	2.64	0	5

Table 24: *Fall A Sentence Embedded Consonant Post Test Descriptive Statistics*

Phoneme	$\bar{x}$	SD	min	max
/ð/	1.67	2.88	0	5
/θ/	2	2.64	0	5

Summaries of the descriptive statistics for all students in the Fall B (n = 2) term included in the sentence embedded consonant analysis are provided as Table 24 (pre test) and Table 25 (post test). Compared to an L1 English speaker referent with scores of /ð/ of 3 and /θ/ of 6, students in the Fall B term on average maintained their ability to produce the /θ/ phoneme, and regressed in their ability to produce the /ð/ phoneme when embedded in sentences.

Table 25: *Fall B Sentence Embedded Consonant Pre Test Descriptive Statistics*

Phoneme	$\bar{x}$	SD	min	max
/ð/	3	1.41	2	4

/θ/	4	0	4	4

Table 26: *Fall B Sentence Embedded Consonant Post Test Descriptive Statistics*

Phoneme	x̄	SD	min	max
/ð/	5.5	0.7	5	6
/θ/	4	1.41	3	5

Vowel and consonant sentence embedded production graphs for each relevant student are provided below as appendices S and T, respectively. Example vowel and consonant sentence embedded production graphs are provided below as Figures 9 and 10, respectively. As with isolated words, vowel sentence embedded word graphs are formant graphs that display student performance on a sentence embedded production task across six phonemes (/ð, θ, i, ɪ, u, and ʊ/). The y axis shows the first formant, and the x axis the second formant. A note above the chart gives modality attendance context for each student, similarly to the perception and isolated word production charts.

Student 2 seems to have improved their ability to pronounce the /i/ phoneme in sentence embedded contexts in particular. Their pronunciation of the /u/ phoneme rose towards a native English referent in the vocal tract as well, but they still seem to struggle to differentiate between the tense and lax /u/ and /ʊ/ phonemes. Their ability to pronounce /ɪ/ seems to diminish in sentence embedded contexts as well. Their graph was chosen for display to offer comparison between isolated and embedded vowel production.

Student 4 clearly struggled to pronounce the /ð/ and /θ/ phonemes in sentence embedded contexts. Their ability seems to regress from isolated contexts to sentence

embedded contexts. This student was disengaged throughout the term, and may have been negatively affected by their lack of attendance. This student may benefit from targeted instruction on dental fricatives in particular. Their graph was chosen for display to offer comparison between isolated and embedded consonant production.

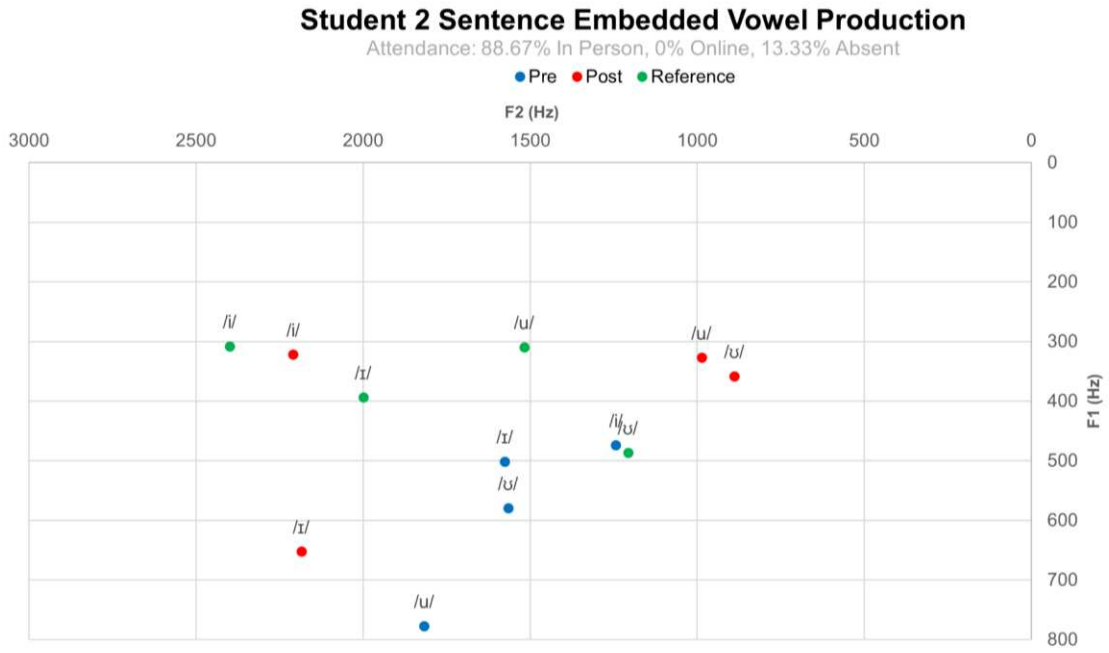

Figure 9: *Student 2 Sentence Embedded Vowel Production*

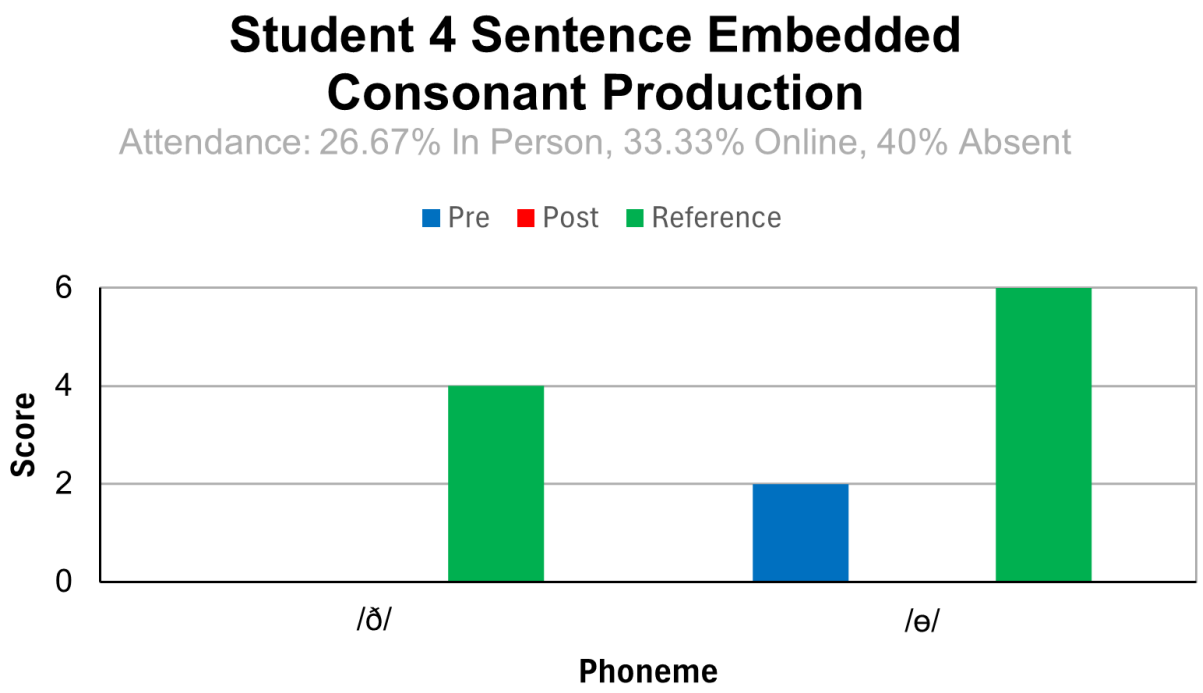

Figure 10: *Student 4 Sentence Embedded Consonant Production*

On average, Fall A students improved in their ability to produce in isolation /i/, maintained their ability to produce in isolation /ð/ and /θ/, and regressed in their ability to produce in isolation /ɪ/, /u/, and /ʊ/. On average, Fall A students improved in their ability to produce in sentence embedded contexts /i/, maintain their ability to produce in sentence embedded contexts /ð/ and /θ/, and regressed in their ability to produce in sentence embedded contexts /ɪ/, /u/, and /ʊ/. On average, Fall B students improved in their ability to produce in isolation /ʊ/, maintained their ability to produce in isolation /ð/, and regressed in their ability to produce in isolation /θ/, /i/, /ɪ/, and /u/. On average, Fall B students improved in their ability to produce in sentence embedded contexts /i/, /ɪ/, and /u/, maintained their ability to produce in sentence embedded contexts /θ/, and regressed in their ability to produce in sentence embedded contexts /ð/ and /ʊ/.

Attendance

Attendance serves as an important way to operationalize the impact that hybrid flexible instruction has on learning outcomes. Tracking attendance data is one way to quantify student participation, and can show how that participation, whether in person or online, relates to their performance on pronunciation tasks. Attendance data graphs for all students included in either perception or production analyses are provided below as appendix U. An example attendance graph is given below as Figure 11. Attendance data graphs display student attendance across three multi day instructional units focused on a pair of phonemes (/ð/ and /θ/, /i/ and/ ɪ/, and /u/ and /ʊ/), each consisting of three lessons. The y axis shows the percentage of total unit attendance, with each stacked bar indicating the proportion the student attended in person (black) and online (gray). 9 total lessons are depicted in these graphs.

A summary of student attendance in the Fall A (n = 6) and Fall B (n = 3) terms according to modality is given below as Table 27 and Table 28, respectively. A summary of student attendance in the Fall A and Fall B terms according to lesson is given below as Table 29 and Table 30, respectively. Four students who initially attended classes during the Fall A term were ultimately excluded from analysis due to disengagement and eventual attrition. Two students from Fall A who were included in analyses, along with a student who was excluded from analyses, also attended during the Fall B term. Data were not collected from repeat students to avoid confounding variables. No attrition occurred during the Fall B term.

Table 27: *Fall A Modality Attendance*

Modality	% Total	$\bar{x}$	SD	min	max
In Person	71.4 (75/105 possible)	10.71	3.19	4	13

Online	8.6 (9/105 possible)	1.29	1.79	0	5
Absent	20 (21/105 possible)	3	1.73	1	6

Table 28: *Fall A Lesson Attendance*

Lesson	% Total	x̄	SD	min	max
/ð/ and /θ/	71.4 (15/21 possible)	2.14	0.69	1	3
/i/ and /ɪ/	85.7 (18/21 possible)	2.57	0.79	1	3
/u/ and /ʊ/	85.7 (18/21 possible)	2.57	0.53	2	3

Table 29: *Fall B Modality Attendance*

Modality	% Total	x̄	SD	min	max
In Person	51.1 (23/45 possible)	7.67	6.81	0	13
Online	33.3 (15/45 possible)	5	7.81	0	14
Absent	15.6 (7/45 possible)	2.33	1.53	1	4

Table 30: *Fall B Lesson Attendance*

Lesson	% Total	x̄	SD	min	max
/ð/ and /θ/	100 (9/9 possible)	3	0	3	3
/i/ and /ɪ/	66.67 (6/9 possible)	2	0	2	2

/u/ and /ʊ/	100 (9/9 possible)	3	0	3	3

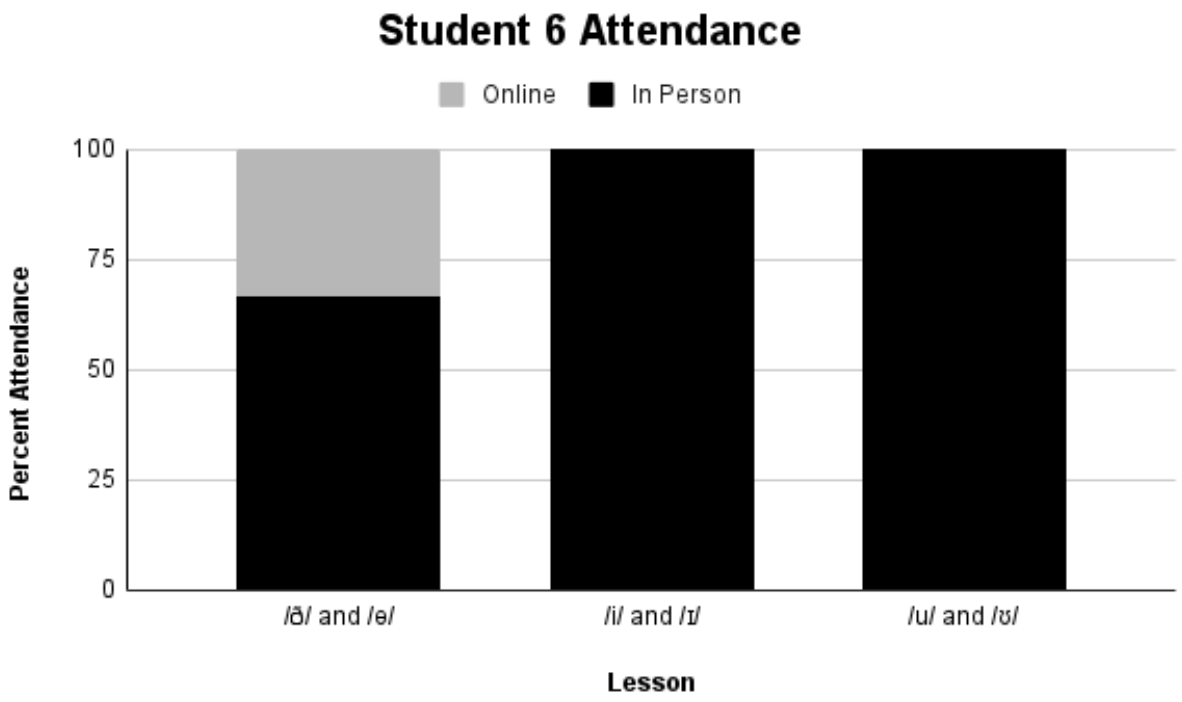

Figure 11: *Student 6 Attendance Graph*

Note: This graph depicts the attendance of student 6 during each of the 9 total content lessons throughout the Fall A term. This student attended two of three /ð/ and /θ/ lessons in person and one online, and three of three /i/ and /ɪ/ and /u/ and ʊ/ lessons in person throughout the term.

DISCUSSION

The following individual case studies are examined in reference to the PAM (Best et al., 1988) and the SLM (Fledge, 1995) discussed above, as well as to each student's engagement with the hybrid flexible classroom environment offered. Reference to functional load and prestige will also guide case study analysis. Acquisition of phonemic contrasts may be explained considering each student's language background, attendance modalities, learning goals, and general class engagement. The pedagogical implications of these results, limitations associated with the present study, and recommendations for future research will also be presented below.

Importantly, student performance in either perception or production tasks labeled as "regressed" throughout the present study may not signal true student decline in pronunciation skill abilities. A better word to label decreases in performance from pre to post testing may well be uncertainty. Students may not be regressing in their ability to perceive or produce a given phoneme, and may instead be in the process of forming a new perceptual category that indeed differentiates between a L1 phoneme they have familiarity with from that of a novel English phoneme.

Regarding production performance, students were measured in their ability to replicate a prestigious native English speaking instructor. The essential nature of the production tasks was a measurement of students' abilities to learn native like pronunciation, and not necessarily their ability to become more intelligible, because students were only exposed to a single instructor model throughout the course. Instructors may choose to provide a more diverse set of pronunciation models in future

iterations of this research, but doing so may cause the creation of larger and less specifically defined perceptual categories, and potentially less ability to be intelligible.

Case Studies

Student 1 is a Spanish L1 speaker that participated primarily in person throughout the Fall A term. He attended 11 of 15 total classes, and provided a complete pre and post perception test. He also provided pre and post production tests, but did not follow instructions entirely and so was excluded from analysis. He maintained his ability to perceive differences between the /i/ and /ɪ/ phonemes, but declined in his ability to distinguish between the /ð/ and /θ/ and /u/ and /ʊ/ phonemes. This student's data can be referenced on pages 95, 145, and 162.

His difficulties distinguishing between the /ð/ and /θ/ phoneme may be attributable to his lower attendance during their lessons, or to PAM single category assimilation. Spanish does not have either phoneme (Avelino, 2018), so it is possible that he is assimilating these less familiar sounds to similar existing categories in his L1, such as /d/ or /t/. The SLM predicts that he would have trouble distinguishing between the /i/ and /ɪ/ phonemes and between the /u/ and /ʊ/ phonemes, because the lax vowels do not exist in Spanish, and his ability to maintain perception of the differences between the /i/ and /ɪ/ phonemes may be partially attributable to his perfect attendance during their lessons. His highest performance was associated with in person engagement, and his largest regression was associated with online engagement, suggesting that in person exposure to model English pronunciation was most impactful for this student.

Student 2 is a Russian L1 speaker that participated entirely in person throughout the Fall A term. He attended 13 of 15 classes, provided an entire data set, followed all

testing instructions, and was generally very engaged throughout the term. He improved in his ability to perceive the /θ/ and /ʊ/ phonemes, maintained his ability to perceive the /ð/, /i/, and /u/ phonemes, and regressed in his ability to perceive the /ɪ/ phoneme. His ability to produce the phonemes /i/, /ɪ/, and /u/ in isolation improved, as did his ability to produce the phonemes /i/ and /u/ in sentence embedded contexts. This student's data can be referenced on pages 95, 96, 145, 150, 153, 156, 159, and 162.

Student 2's inability to produce differentiated /u/ and /ʊ/ phonemes may be partially attributable to his lower attendance for these phonemes' associated lessons, and may be understood in reference to the PAM, which suggests that he may be assimilating the lax phoneme to an existing /u/ category from Russian (Yanushevskaya, 2015). In accordance with the SLM, he slightly improved in his ability to perceive differences between the /ð/ and /θ/, and maintained his ability to produce these phonemes, and Russian lacks these fricatives, suggesting that he benefited from in person instruction of these phonemes. His relative difficulty with the /ɪ/ phoneme may be attributable to negative interference effects from the near counterpart [ɨ] present in his L1.

Student 3 is a Spanish L1 speaker that participated entirely in person throughout the Fall A term. She attended 13 of 15 classes and provided a complete pre and post perception test. She also provided a pre and post production test, and a mid 2 perception and production test, but did not follow instructions appropriately, and so her data was omitted from data analysis. She improved in her ability to perceive the /θ/ and /ɪ/ phonemes, maintained her ability to perceive the /ð/, /i/, and /ʊ/ phonemes, and

regressed in her ability to perceive the /u/ phoneme. This student's data can be referenced on pages 95, 96, 146, and 163.

Student 3's perfect attendance during /ð/ and /θ/ may explain her ability to improve in her ability to distinguish between these phonemes which are not present in most dialects of Spanish, and not in her Colombian dialect (Markič, 2017). The PAM predicts that she may have had difficulty with these phonemes, potentially assimilating them to the /s/ or /t/ phonemes in Spanish, but her high attendance may have helped in establishing their distinctiveness. Her slight regression in her ability to perceive differences between the /u/ and /ʊ/ phonemes may be explained in light of the PAM. It is possible that she assimilated the /ʊ/ phoneme, not present in Spanish, to the /u/ phoneme, causing her confusion. She also missed a single /u/ and /ʊ/ lesson, so this confusion may be partially attributable to this disengagement as well. Her performance regarding the /ð/, /θ/, /i/, and /ɪ/ phonemes suggest that she generally benefited from in person direct pronunciation instruction.

Student 4 is a Mexican Spanish L1 speaker that participated primarily online throughout the Fall A term. She attended 9 of 15 classes and provided a complete set of pre and post perception and production data. Her lack of mid 1 and mid 2 test data was due to her failure to turn in this data asynchronously via WhatsApp, an example of disengagement potentially brought by the online modality of the class. She improved her ability to produce the isolated /θ/ phoneme, maintained her ability to perceive the /ð/, /θ/, /i/, and /ɪ/ phonemes and produce the isolated and embedded /i/, /u/, and /ʊ/ phonemes and the embedded /ð/ phoneme, and regressed in her ability to perceive the /u/ and /ʊ/ phonemes and produce the isolated /ð/ and /ɪ/ phonemes and the embedded

/θ/ phonemes. This student's data can be referenced on pages 95, 96, 146, 150, 153, 156, 159, and 163.

It is possible that student 4's limited in person exposure to the vowel contrast lessons days, due to both her absence and her attendance online, contributed to her relative inability to produce differentiated vowels in either the isolated or embedded contexts. Her regression in her ability to perceive the tense and lax /u/ and /ʊ/ may be attributable to this as well, though she did attend each of their lessons online. It is possible that this regression is evidence of single category assimilation associated with the PAM, as Spanish does not have the lax vowel /ʊ/ (Avelino, 2018). This could partially explain her inability to produce distinct /i/ and /ɪ/ as well, though so could her low attendance during their associated lesson days. Of each of the students included in the present study's analyses, student 4 was the least engaged, and some of this disengagement seems to have been brought by her participation in the online format.

Student 5 is a Brazilian Portuguese L1 speaker that participated primarily in person throughout the Fall A term. She attended 13 of 15 classes and provided a complete set of perception test data, and a set of pre, mid 1, and mid 2 production data. She was ultimately left out of production data analysis because of her failure to provide a production post test. She improved in her ability to perceive the /ð/, /u/, and /ʊ/ phonemes, maintained her ability to perceive the /ɪ/ phoneme, and regressed in her ability to perceive the /θ/ and /i/ phonemes. This student's data can be referenced on pages 95, 96, 147, and 164.

Student 5's biggest perception gains were made in phonemes not present in Portuguese. Her decreased perception accuracy for the /θ/ dental fricative, despite her

increase for the /ð/ phoneme given their shared lesson time, may reflect single category assimilation in the PAM, potentially to the /f/ present in Portuguese (Barbosa, 2004). She may have over focused on the /ð/ phoneme to the detriment of its contrasting English /θ/, and her absence during one of these lessons, and potentially also her attendance in the online modality of the class, may have contributed to this difficulty. She may have required additional instruction in order to learn to differentiate these two phonemic categories. Her improvements in both the tense and lax /u/ and /ʊ/ phonemes might suggest two category assimilation has occurred in her perception learning, that might have been brought about by instruction, as she attended each of their associated lessons, and entirely in person. Student 5's perception accuracy seems to have benefitted from the in person modality of the class.

Student 6 is another Brazilian Portuguese L1 speaker that participated primarily in person throughout the Fall A term. She attended 14 of 15 classes and provided a complete set of perception and production data. She improved in her ability to perceive the /ð/ and /θ/ phonemes and produce the embedded /θ/, /ɪ/, /u/ and /ʊ/ phonemes, maintained her ability to perceive the /u/ phoneme and produce the /ð/ phoneme in isolated and embedded contexts, and regressed in her ability to perceive the /i/, /ɪ/, and /ʊ/ phonemes and produce the /ð/, /θ,/ /i/, /ɪ/, and /u/ phonemes in isolated contexts, and produce the /i/ and /ʊ/ phonemes in embedded contexts. This student's data can be referenced on pages 95, 96, 147, 151, 154, 157, 160, and 164.

Despite her excellent engagement in the class overall, student 6 demonstrated mixed perception and production outcomes. Perception gains were observed for both the /ð/ and /θ/ phonemes, as were production gains for the /ð/ phoneme, suggesting

that she began to form a new phonemic category for a sound not present in her L1 (Barbosa, 2004). These gains align with the SLM, which posits that sufficient exposure can support eventual category development for unfamiliar sounds. It is possible that challenges associated single category assimilation described by the PAM caused her difficulties with the perception and production of the /ɪ/ and /u/ phonemes, which are absent in Portuguese. Student 6 may require more intensive instruction to support her production of unfamiliar segments.

Student 7 is a French L1 speaker that participated entirely in person throughout the Fall B term. She attended 13 of 15 classes and provided a complete set of perception and production data. Student 7 showed notable improved performance in the perception task for all target phonemes. Student 7 also showed improved differentiation while producing the /u/ and /ʊ/ phonemes in isolated and sentence embedded contexts, though her production of /i/ and /ɪ/ phonemes remained relatively constant, as did her production of /ð/ and /θ/ phonemes in both isolated and sentence embedded contexts. This student's data can be referenced on pages 95, 96, 148, 151, 154, 157, 160, and 165.

Student 7's improvements in the perception of the /ɪ/ phoneme and production of the /ʊ/ phoneme may suggest the successful formation of new phonemic categories after direct instruction predicted by the SLM. These phonemes have no direct French equivalents (Fougeron and Smith, 2009). Her success may be attributable to her in person attendance, with her greatest success with the /u/ and /ʊ/ phonemes potentially due to her perfect attendance during those lesson days. Her slight regression in ability to produce isolated and sentence embedded /θ/ may be evidence of single category

assimilation, potentially to the voiceless /s/. French lacks dental fricatives (Fougeron and Smith, 2009), so she and other French students may need more direct instruction, potentially afforded by the hybrid flexible format, in order to begin to form new phonemic categories for these sounds.

Student 8 is another French L1 speaker that participated primarily in person throughout the Fall B term. She attended 11 of 15 classes and provided a complete set of pre, mid 1, and post perception and production data. She was in attendance in person for the mid 2 testing day as well, but immediately left the class due to illness. She improved in her ability to perceive the /i/ and /ɪ/ phonemes, and her strange drop in ability to perceive the /u/ and /ʊ/ phonemes may be attributable to confusion regarding test instructions. She regressed in her ability to produce the vowel phonemes in both isolated and sentence embedded contexts, and generally in her ability to produce the dental fricatives as well. This student's data can be referenced on pages 95, 96, 148, 152, 155, 158, 161, and 165.

Her difficulties with the /ð/ and /θ/ phonemes might be evidence of single category assimilations, however, she attended each of their relevant instruction days. The SLM holds that creation of new phonemic categories can be achieved given enough instruction time, so it might be that she needs more input before production success for these phonemes is possible. Her lack of attendance during one of the /i/ and /ɪ/ lessons may explain her inability to produce these distinctly, as may her linguistic background, as French lacks the lax vowel /ɪ/ (Fougeron and Smith, 2009). Student 8 may benefit from further instruction, whether it be in an in person or online setting.

Student 9 is a Thai L1 speaker that participated entirely online throughout the Fall B term. She attended 14 of 15 classes and provided a complete set of perception data, as well as a set of pre, mid 1, and mid 2 production data. Student 9 also provided a post production data set, but she was given help during this test by her husband, who often helped her during lessons generally, and so her post test data was deemed unusable. She improved in her ability to perceive the /ð/ and /θ/ phonemes, maintained her ability to perceive the /i/ and /ɪ/ phonemes, and regressed in her ability to perceive the /u/ and /ʊ/ phonemes. This student's data can be referenced on pages 95, 96, 149, and 166.

Student 9's increased ability to perceive the /ð/ and /θ/ phonemes is interesting and seems to conflict with the PAM, which would predict difficulty due to the lack of these segments in Thai and the possibility of her assimilating these sounds to near by correlates present in Thai like the voiceless /t/ or voiced /d/ phonemes (Tingsabadh, 1993). The SLM holds that her ability to learn these phonemes is possible given enough instructional time, and her perfect attendance, though entirely online, may have been enough to help her begin to form new phonemic categories for these sounds. Her regressed ability to perceive the /u/ and /ʊ/, especially given her perfect online attendance during their associated lessons, might suggest that she inappropriately assimilated the /ʊ/ sound, not present in Thai, to the /u/ sound, which is. Her data seems to be in accordance with the PAM and SLM, and suggests that online only learners can develop new perceptual phonemic categories, but only for certain phoneme contrasts, especially those that do not have equivalents in a learner's L1.

Students in the present study did show meaningful pronunciation learning, variable according to their L1 backgrounds and classroom engagement levels and modality preferences. Students often struggled with phonemes absent in their native languages, potentially committing errors associated with single category assimilation. Students participating in the in person modality of class often had stronger learning outcomes than did students participating in the online modality, though specific instruction may still be beneficial to online students. These case studies suggest that instructional format, as well as overall engagement and L1 influence, are important considerations when teaching pronunciation.

Implications

It is possible that the online modality of the hybrid flexible classroom in the present study contributed to overall student disengagement and may have also led to decreased performance on pronunciation tasks. Two students who initially engaged with the class in the online modality eventually attritted, and several student learning outcomes may have been negatively impacted by online participation during instructional days. Porter Szucs and DeCicco (2022) reported higher student engagement in the in person modality of a triple hybrid graduate level TESOL course, suggesting that similar community building challenges may have been present here as well. Harringtons' (2010) concern of "instructional schizophrenia" may have applied, particularly given the infeasibility of the testing procedures following the shift from a co-instructor to a single instructor model mandated by FRCC. Unfocused implementation of the format may have challenged Garrison and Vaughn's (2008) concept of social

presence in particular, potentially alienating students who attempted to engage with the class online.

Detyna et al. (2023) warn that ”if students attending face-to-face feel that they are getting a better experience than those attending online or vice versa, this could be detrimental to student equity." (p. 156). Although hybrid flexible formats are often promoted as tools for expanding educational access, the present study suggests that poor implementation may in fact diminish learning outcomes, particularly for those participating online. Interestingly, the only students in the present study who completed all of the tests and followed all of the testing instructions attended entirely in person. Given the substantial resource demands of the hybrid flexible format, ESL programs should approach its adoption cautiously.

Limitations and Future Research

This study faced several methodological and contextual limitations that should inform future iterations researching the hybrid flexible classroom’s ability to teach segmental pronunciation. The principal limitation of this research was feasibility. The original research design required a co-instructor, but shortly before the Fall term began, FRCC reassigned all courses to single instructors due to budget and enrollment constraints. This shift made the planned testing procedures especially difficult. The original term schedule included structured makeup testing for absent students on the following lesson day, with the co-instructor delivering supplemental content. Without the support of a co-instructor, administering makeup tests became impractical.

The test proctoring itself was not feasibly designed for a single instructor to manage either. Some components of each test required students to record

pronunciation samples in a separate room individually while the lead teacher proctored, which meant that substitute instructors were needed to lead the rest of the students through supplementary instruction. However, these substitutes were not adequately prepared to teach these materials, and exposure to potentially different teaching strategies may have introduced confounds. Future iterations should be designed with a single instructor model in mind, using fewer tests (e.g. pre, a single mid, and post tests only) and built in “flex” days to allow for student absences and makeup testing.

The design of the testing materials, and in particular the instructions for each perception and production subtest, caused some confusion among students. In addition to previously noted issues with following directions to read words and sentences silently before saying them aloud (to mimic spoken intonation), some students wrote down perception answers differently than expected, failed to send completed test data sets via Whatsapp when attending online, or received help from others at home despite being expected to work independently. Previous literature has already established some of the challenges of classroom research. Al-Nouth et al.’ (2013) research found that unclear test instructions can lead to unreliable data in university EFL settings. It is possible that the hybrid flexible format exacerbates these challenges. The instructor in the present study may have had less ability to ensure that online students followed testing and submission procedures.

Another major limitation was the lack of comparison groups. Without parallel implementations of the same curriculum in fully online synchronous and in person classrooms, it is difficult to associate pronunciation learning outcomes to the hybrid flexible format itself. Learning outcomes might be influenced by individual student

differences, variable instructor feedback strategies, or other confounding variables. Future studies should include such comparison groups to allow for more nuanced claims about how each modality affects segmental pronunciation learning. Without them, conclusions about the influence of the hybrid flexible format remain tentative and less generalizable.

This study also did not measure incidental exposure to target phonemes during lessons. More frequent exposure to more commonly used segments (i.e. /i/ and /ɪ/) may have unintentionally influenced learning. Utterances from the instructor, and certainly from students, cannot and should not be controlled to the point of inflexibility to students' learning needs, but could be easily recorded and quantified with hardware already present in the class and additional transcription software. Prior research has suggested that incidental vocabulary exposure may be associated with improved acquisition (Heidari-Shahreza et al., 2014), suggesting that a similar effect could apply to segmental features.

There are additional limitations worth noting. First, as the study took place within a single institutional and course section context, findings may not be generalizable to other ESL programs or the broader second language acquisition field. Second, the principal research was also the lead instructor, which may have introduced data interpretation bias or influenced lesson delivery. Finally, students may have had variable access to either the online synchronous or in person formats of the class, suggesting a need for more structured tracking or control of these variables. Several aspects of the study design could be improved in future iterations to more appropriately assess the hybrid flexible format's amenability to teaching segmental pronunciation.

Conclusion

The present study offers preliminary evidence of how a hybrid flexible classroom format may impact the perception and production of segmental features of English pronunciation in an ESL context. Case study analysis suggests that while some learners demonstrated meaningful phonological gains, others show limited improvement or even regression, often linked to disengagement that may have been brought about by the online modality of the classroom. Students who participated primarily in person tended to be more engaged and have more phonetic learning outcomes. Hybrid flexible instruction is meant to increase student educational equity, but the present study suggests that without intentional design, the format may have negative implications. ESL programs interested in the format should carefully construct classrooms to be as feasibly implemented as possible, and future research should compare learning outcomes in the format to purely in person and online formats to determine with more nuance which elements most effectively support learning in segmental pronunciation.

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APPENDICES

APPENDIX A

Consent Form

Colorado State University Consent to Participate in Research

The Effects of a Hybrid-Flexible English as a Second Language Classroom on the Perception and Production of Segmental Features of Pronunciation

Introduction and Purpose: My name is Kale Hubert. I am a graduate student at Colorado State University. I work with my faculty advisor, Dr. Luciana Marques in the English Department. I would like to invite you to take part in my research study. The study aims to understand how participation in an online or an in person classroom affects pronunciation of words in English.

Procedures: If you agree to participate in my research, I will record your performance on listening and speaking tests in pronunciation tasks. Your pronunciation of various English tasks will be recorded into an audio file for later analysis. You will be asked to read English out loud and listen to English from your teachers. Your scores will be recorded into a file on the researcher's computer. Your attendance will also be recorded. Our Zoom meeting's audio will be recorded and transcribed by the researchers into a text file. Our WhatsApp group's text will also be recorded. If you choose not to participate in the research, you will still be able to take the class without any negative consequence. If you choose not to participate in the research, your presence in the Zoom class and WhatsApp group will not be included in the recordings.

Benefits: There is no direct benefit to you from taking part in this study. We hope that the research will benefit the field of second language speech and production. There are potential teaching implications for the teaching of pronunciation in online classes. Risks/Discomforts There are no potential risks or discomforts from your study participation. You are free to stop participating at any time. As with all research, there is a chance that confidentiality could be compromised, but we are taking precautions to minimize this risk.

Confidentiality: Your study data will be handled as confidentially as possible. If the results of this study are published or presented, your name and other personally identifiable information will not be used. We will keep the data on the researcher's computer and will require a password to access it. When the research is completed, we will save the data for up to 3 years after the study is over. We may be asked to share

the research files with the sponsor or the CSU Institutional Review Board ethics committee for auditing purposes.

Compensation: You will not be compensated for your participation.

Rights: ***Participation in research is completely voluntary.*** You are free to decline to take part in the project. You can decline to answer any questions and are free to stop taking part in the project at any time. Whether or not you choose to participate in the research and whether or not you choose to answer any questions or continue participating in the project, there will be no penalty to you or loss of benefits to which you are otherwise entitled.
Questions: If you have any questions about this research, please contact me, Kale Hubert by email at kale.hubert@colostate.edu. You may also contact Dr. Marques at luciana.marques@colostate.edu.

If you have any questions about your rights or treatment as a research participant in this study, please contact the Colorado State University Institutional Review Board (IRB) at: 970-491-1553, or e-mail RICRO_IRB@mail.colostate.edu.

********** CONSENT **********

Do you consent to participate in this study?

___Yes ___No

If you wish to participate in this study, please sign and date below. You will be given a copy of this consent form to keep for your own records.

_____ Participant's Name (please print)

_____ Participant's Signature

_____ Date

APPENDIX B

Student Demographic Data Table 1

Student	Included Analyses	Term	Sex	Age	Country	Time in US
1	Perception	Fall A	M	38	Peru	2 years, 6 months
2	Perception and Production	Fall A	M	44	Russia	2 years, 5 months
3	Perception	Fall A	F	25	Colombia	7 months
4	Perception and Production	Fall A	F	46	Mexico	12 years
5	Perception	Fall A	F	23	Brazil	2 months
6	Perception and Production	Fall A	F	26	Brazil	2 months
7	Perception and Production	Fall B	F	22	France	2 weeks
8	Perception and Production	Fall B	F	22	France	2 weeks
9	Perception	Fall B	F	41	Thailand	1 year, 2 months

Student Demographic Data Table 2

Student	Included Analyses	Highest School	Formal English	Informal English	L1	LO
1	Perception	Bachelor's Degree	8 months	2 months	Spanish	N/A

2	Perception and Production	Master's Degree	2 years, 6 months	33 years	Russian	N/A
3	Perception	Bachelor's Degree	2 years	2 years	Spanish	N/A
4	Perception and Production	High School	1 month	N/A	Spanish	N/A
5	Perception	High School	2 years, 9 months	N/A	Portuguese	N/A
6	Perception and Production	Bachelor's Degree	1 year, 5 months	1 year	Portuguese	Spanish
7	Perception and Production	Bachelor's Degree	13 years	N/A	French	Portuguese and Spanish
8	Perception and Production	Bachelor's Degree	2 years	N/A	French	N/A
9	Perception	High School	6 months	N/A	Thai	N/A

APPENDIX C

Corpus of Contemporary American English Selected Word List /i/

Word	Part of Speech	COCA Rank	Term	Lesson	Lesson Sentence	Test Sentence
be	verb	2	B	1	I could be here.	
see	verb	56	A	2	I see red apples.	
people	noun	62	A	2	I love new people.	I value old people.
year	noun	64	B	2	I vacation every year.	I like this year.
here	adverb	78	A	3	I live here.	
need	verb	107	A	3	I need new clothes.	I need your attention.
even	adverb	111	A	1	I do even better.	I do even worse.
only	adverb	112	B	3	I only eat steak.	
really	adverb	114	A	1	I really love cartoons.	
mean	verb	130	B	3	I mean everything.	
feel	verb	136	B	3	I feel very tired.	I feel every scratch.
keep	verb	151	B	1	I keep my dog.	
leave	verb	152	A	2	I leave	I leave

					after class.	work.
seem	verb	181	A	2	I seem smart.	
believe	verb	189	B	2	I believe her.	
week	noun	192	A	3	I have a long week.	I plan every week.
story	noun	224	A	1	I tell a story.	
read	verb	244	B	2	I read every night.	
real	adjective	280	B	1	I eat real bacon.	I drink real coffee.
team	noun	282	B	1	I love our team.	I support his team.
meet	verb	294	A	1	I meet kind people.	I meet strange folk.
least	adverb	323	A	3	I talk least.	
speak	verb	337	B	3	I speak in class.	I speak in tongues.
research	noun	383	B	2	I study new research.	I write great research.

APPENDIX D

Corpus of Contemporary American English Selected Word List /ɪ/

Word	Part of Speech	COCA Rank	Term	Lesson	Lesson Sentence	Test Sentence
will	verb	47	A	3	I will be done.	I will graduate.
give	verb	98	B	1	I give presents.	
still	adverb	128	B	3	I still drink soda.	I still make pies.
in	adverb	135	B	3	I come in the door.	
big	adjective	156	A	1	I love big dogs.	
live	verb	209	B	1	I live for Mondays.	
bring	verb	213	A	3	I bring food.	I bring the pain.
little	adjective	238	B	2	I hate little dogs.	I eat little snacks.
business	noun	254	B	2	I run a business.	
issue	noun	261	A	1	I have an issue.	I like this issue.
kid	noun	275	B	1	I know that kid.	
sit	verb	318	A	2	I sit on benches.	
kill	verb	325	A	1	I kill the game.	
win	verb	347	A	2	I win every	I win all games.

					match.	
continue	verb	350	A	3	I continue every week.	I continue my homework.
political	adjective	356	B	2	I like political cartoons.	I hate political rhetoric.
history	noun	374	B	3	I study history.	I understand history.
build	verb	425	B	2	I build large houses.	
listen	verb	460	B	1	I listen to metal.	I listen to her.
interest	noun	473	A	1	I appreciate your interest.	
six	numerical	508	A	2	I eat six pears.	
situation	noun	560	A	2	I fear this situation.	I anticipate this situation.
image	noun	577	A	3	I love your image.	
simply	adverb	580	B	3	I draw simply.	I write simply.

APPENDIX E

Corpus of Contemporary American English Selected Word List /ʊ/

Word	Part of Speech	COCA Rank	Term	Lesson	Lesson Sentence	Test Sentence
would	verb	49	A	1	I would run tomorrow.	
could	verb	75	B	3	I could fly tomorrow.	I could skate Friday.
look	verb	81	A	1	I look outside.	
good	adjective	93	B	2	I appreciate good books.	
should	verb	110	A	1	I should walk tomorrow.	I should drive Monday.
woman	noun	126	A	3	I like that woman.	I love this woman.
put	verb	153	B	2	I put lotion on.	
book	noun	218	B	1	I relish the book.	
foot	noun	458	A	1	I hurt my foot.	I tape my foot.
full	adjective	470	A	3	I lift full buckets.	I eat full cakes.
pull	verb	503	B	3	I pull my weight.	
push	verb	724	A	2	I push the sled.	I push your buttons.

football	noun	1401	A	3	I play football.	
cook	verb	1636	B	1	I cook great meals.	I cook often.
sugar	noun	1842	A	2	I like sugar.	I hate sugar.
bullet	noun	2710	A	2	I drop the bullet.	
wolf	noun	2735	B	2	I see a wolf.	I own a wolf.
cookie	noun	2934	A	3	I gave a cookie.	
bull	noun	3486	A	2	I raised a bull.	
cooking	noun	3764	B	3	I love her cooking.	I hate her cooking.
hook	noun	3984	B	1	I have a hook.	
goodness	noun	4194	B	1	I thank goodness.	I taste goodness.
bush	noun	4291	B	3	I burn the bush.	I move the bush.
footage	noun	4747	B	2	I tape the footage.	

APPENDIX F

Corpus of Contemporary American English Selected Word List /u/

Word	Part of Speech	COCA Rank	Term	Lesson	Lesson Sentence	Test Sentence
do	verb	15	A	1	I do homework.	
two	numerical	90	B	1	I have two computers.	
use	verb	91	B	3	I use the whiteboard.	I use my pencils.
new	adjective	100	A	2	I prefer new music.	I like new movies.
school	noun	146	A	1	I enjoy school.	
student	noun	179	B	3	I greet a new student.	I need a new student.
move	verb	227	B	2	I move the pit.	
room	noun	264	A	1	I decorate my room.	I love my room.
lose	verb	273	B	3	I lose my keys.	I lose my mind.
include	verb	328	A	2	I include everyone.	I include my girlfriend.
food	noun	378	A	2	I cook amazing food.	I eat American food.

true	adjective	414	A	2	I tell true stories.	
choose	verb	561	B	1	I choose to conquer.	
soon	adverb	614	B	2	I will see you soon.	I will jump soon.
rule	noun	617	B	3	I break every rule.	
opportunity	noun	643	B	1	I recognize every opportunity.	
shoot	verb	657	A	3	I shoot accurately.	
usually	adverb	786	A	1	I usually dress well.	I usually do homework.
reduce	verb	809	B	2	I reduce my waste.	
blue	adjective	940	A	3	I hate blue socks.	
assume	verb	1001	A	3	I assume the worst.	I assume she left.
cool	adjective	1019	A	3	I wear cool shoes.	
user	noun	1081	B	2	I have a new user.	I know a user.
tool	noun	1093	B	1	I need that tool.	I have a tool.

APPENDIX G

Corpus of Contemporary American English Selected Word List /ð/

Word	Part of Speech	COCA Rank	Term	Lesson	Lesson Sentence	Test Sentence
other	adjective	74	A	2	I eat other fruits.	
then	adverb	79	A	2	I eat then.	I drink then.
mother	noun	279	B	3	I love my mother.	I miss my mother.
father	noun	317	A	1	I like my father.	I envy my father.
together	adverb	330	A	1	I eat together with her.	I speak together with him.
either	adverb	537	B	3	I do not feel it either.	I do not love her either.
brother	noun	574	A	2	I enjoy my brother.	
thus	adverb	820	B	2	I tear paper thus.	I wrap presents thus.
rather	adverb	842	B	1	I am rather cold.	
therefore	adverb	1085	B	3	I am therefore upset.	I therefore drink coffee.
otherwise	adverb	1377	A	1	I am otherwise well.	
southern	adjective	1429	B	3	I like southern	I enjoy southern

					food.	culture.
clothes	noun	1606	B	1	I wear fancy clothes.	
gather	verb	1633	B	2	I gather nuts.	I gather video games.
neither	adverb	1897	A	3	I feel it neither.	
bother	verb	1962	A	3	I bother my friends.	I bother her mother.
northern	adjective	2021	A	2	I prefer northern cities.	I enjoy northern weather.
breathe	verb	2025	B	2	I breathe underwater.	
grandmother	noun	2822	B	1	I love my grandmother.	
smooth	adjective	2903	B	1	I like smooth rocks.	I have smooth fabric.
clothing	noun	3084	A	3	I wear nice clothing.	
nevertheless	adverb	3132	A	1	I nevertheless read poems.	
grandfather	noun	3323	B	2	I hear my grandfather.	
furthermore	adverb	3330	A	3	I furthermor	

					e drink alone.	

APPENDIX H

Corpus of Contemporary American English Selected Word List /θ/

Word	Part of Speech	COCA Rank	Term	Lesson	Lesson Sentence	Test Sentence
think	verb	53	A	3	I think too much.	I think you rule.
thing	noun	86	A	2	I hold this thing.	I have a thing.
three	numerical	163	B	1	I feel three fingers.	I have three toes.
month	noun	249	A	1	I adore this month.	
thank	verb	300	A	3	I thank you.	
health	noun	333	B	2	I have my health.	
both	adverb	396	A	3	I cook both quickly.	I love both equally.
death	noun	419	A	2	I fear death.	I think about death.
thanks	noun	494	B	3	I owe thanks.	
throw	verb	635	B	3	I throw footballs.	I throw tennis balls.
third	numerical	636	A	2	I like the third.	
author	noun	680	A	2	I loathe this author.	I inspire this author.

truth	noun	681	B	1	I value truth.	I tell the truth.
thought	noun	692	B	1	I have a thought.	I forget my thought.
north	noun	703	A	3	I travel north.	
earth	noun	725	A	1	I love earth.	I miss earth.
south	noun	801	B	2	I wander south.	
growth	noun	889	B	1	I have a growth.	I want more growth.
theory	noun	896	B	2	I like that theory.	
authority	noun	909	A	1	I have no authority.	
method	noun	911	B	3	I try a new method.	
mouth	noun	1126	A	1	I close my mouth.	
threat	noun	1132	B	2	I recognize his threat.	
worth	noun	1175	B	3	I love your worth.	I appreciate your worth.

APPENDIX I

Corpus of Contemporary American English Distractors List

Word	Part of Speech	COCA Rank	Term
have	verb	11	B
say	verb	26	B
go	verb	31	B
get	verb	34	A
can	verb	37	A
know	verb	39	A
so	adverb	48	A
make	verb	50	B
just	adverb	51	B
up	adverb	52	A
time	noun	54	A
out	adverb	59	B
one	numerical	60	A
come	verb	61	B
take	verb	63	B
want	verb	68	A
how	adverb	69	B
now	adverb	72	A
way	noun	82	B
more	adverb	83	B
well	adverb	87	A
also	adverb	89	A

tell	verb	92	B
first	numerical	94	A

APPENDIX J

Example Lesson Slides

Intermediate ESL

Communication & Writing for Success
Fall B
Lesson #9
November 7th, 2024

Zoom Meeting ID: 979 927 2918

1

Agenda

1. Pronunciation Lesson 6
2. **BREAK**
3. Writing Prompts Lesson 8
    a. Present Perfect Tense
    b. Writing Prompt Draft 1
    c. Read Out Loud
    d. Re-Writing Final Draft

2

Voiced /ð/ and Voiceless /θ/ Sounds

Voiced /ð/ Sounds - sounds that vibrate your throat (“hmmmmm”), spelled with th	Voiceless /θ/ Sounds - sounds that don’t vibrate your throat (“huh”), spelled with th
Voiced /ð/ words:	Voiceless /θ/ words:
thus, gather, breathe, grandfather	south, threat, health, theory

3

Listening Task

1. Listen to the words your teacher says.
2. If the word contains a /ð/ sound, write 1.
3. If the word contains a /θ/ sound, write 2.

4

Listening Task

1. health - 2
2. thus - 1
3. grandfather - 1
4. south - 2
5. breathe - 1
6. threat - 2
7. gather - 1
8. theory - 2

5

Speaking Task

1. Get into pairs.
2. One student reads the sentences. Pronounce the **bolded** word with the most stress.
3. The other student listens to the sentences.
4. Switch roles. Read and listen to the sentences again.
5. Listen to your teacher read the sentences.

6

Speaking Task

1. I have my **health**.
2. I tear paper **thus**.
3. I hear my **grandfather**.
4. I wander **south**.
5. I **breathe** underwater.
6. I recognize his **threat**.
7. I **gather** nuts.
8. I like that **theory**.

7

Conversation Task

1. Stay in your pairs. Decide which role you will play.
2. Student 1 starts reading.
3. Student 2 reads next.
4. Take turns. Pronounce the **bolded** word with the most stress.
5. Finish the conversation.

8

Conversation Task

Student 1: You are a university professor.

1. Say that their **theory** on consciousness is interesting.
2. Say that you **gather** that he must have been very smart.
3. Say he was from the southern US, **thus** he was smart.
4. Ask did something challenge his **health**?

Student 2: You are a student in office hours.

1. Say thank you, and that your **grandfather** once told you it.
2. Say yes he was, and that most old men from the **south** are smart.
3. Say he always was, until he received a **threat** from his doctor.
4. Say yes, he found it hard to **breathe** and needed to retire from academia.

9

Role Play

1. Role play a new conversation.
2. Use the image on the next slide.
3. Use words with the th sounds we practiced.
4. Try to find a new word with the th sounds we practiced.

10

Debrief Task

1. Give one example word with a /ð/ sound.
2. Give one example word with a /θ/ sound.
3. Each group should give two examples. One example for each sound.

12

Break

Take a break! We'll be back in ten minutes!

American Slang: Dog - A cool or strong person, usually a male (positive).

13

Writing Prompts Lesson 8

We'll practice our **writing** skills with the following mini lesson:

1. Present Perfect Tense
2. Writing Prompt Draft 1
3. Read Out Loud
4. Re-Writing Final Draft

14

Present Perfect Tense

Let's practice writing some sentences in the present perfect tense with these verbs!

brush → I have brushed the dog.

rent → I have rented the car.

find → I have found a letter.

reproduce → A cockroach has reproduced lately.

fancy → I have fancied candy.

decide → The teacher has decided to become a dictator.

15

Writing Prompt Draft 1

Choose one of the three following writing prompts. Write a paragraph about the prompt that uses the **present perfect tense**.

1. Write a list of your major accomplishments. Be proud!
2. Write a list of things you have never done but would like to do before you kick the bucket.
3. Your son/daughter wants to go out but they haven't finished their chores! Write a list of what they haven't finished.

16

Reading Out Loud

Now practice sharing your writing by **reading out loud**. We will ask questions and make comments about your writing to help you improve it!

Who wants to go first?

17

Re-Writing Final Draft

Now **re-write your first draft** with the questions, feedback, and grammar that we just discussed. You will turn this in to me for written feedback at the end of class!

18

APPENDIX K

Fall B Pre Test

Fall B PreTest

Perception Test:

Number your paper from 1 to 12. Listen to the following words. If the word contains a /ʊ/ sound, write 1. If the word contains a /u/ sound, write 2.

1. bush
2. tool
3. use
4. lose
5. wolf
6. could
7. user
8. student
9. goodness
10. cooking
11. soon
12. cook

Number your paper from 1 to 12. Listen to the following words. If the word contains a /ð/ sound, write 1. If the word contains a /ɵ/ sound, write 2.

1. thought
2. worth
3. therefore
4. thus
5. smooth
6. either
7. throw
8. three
9. southern
10. truth
11. mother
12. growth

Number your paper from 1 to 12. Listen to the following words. If the word contains a /i/ sound, write 1. If the word contains a /I/ sound, write 2.

1. still
2. listen
3. simply
4. team
5. feel
6. little
7. research
8. history
9. political
10. real
11. speak
12. year

Production Test 1:

Read a word silently, then look at me and say the word before moving on.

1. research
2. soon
3. year
4. just
5. either
6. listen
7. three
8. cooking
9. more
10. way
11. thought
12. lose

Read a word silently, then look at me and say the word before moving on.

1. take
2. little
3. tool
4. student
5. growth

6. say
7. simply
8. still
9. southern
10. user
11. feel
12. bush

Read a word silently, then look at me and say the word before moving on.

1. political
2. come
3. truth
4. therefore
5. make
6. could
7. use
8. speak
9. tell
10. how
11. throw
12. mother

Read a word silently, then look at me and say the word before moving on.

1. real
2. out
3. worth
4. go
5. thus
6. history
7. team
8. cook
9. wolf
10. goodness
11. have
12. smooth

Production Test 2:

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I forget my **thought**.
2. I understand **history**.
3. I **therefore** drink coffee.
4. I do not love her **either**.
5. I **still** make pies.
6. I **lose** my mind.
7. I own a **wolf**.
8. I move the **bush**.
9. I **listen** to her.
10. I tell the **truth**.
11. I **throw** tennis balls.
12. I taste **goodness**.

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I support his **team**.
2. I know a **user**.
3. I **cook** often.
4. I drink **real** coffee.
5. I hate her **cooking**.
6. I hate **political** rhetoric.
7. I **use** my pencils.
8. I have **smooth** fabric.
9. I need a new **student**.
10. I miss my **mother**.
11. I have a **tool**.
12. I **feel** every scratch.

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I write great **research**.
2. I want more **growth**.
3. I have **three** toes.
4. I **speak** in tongues.
5. I will jump **soon**.

6. I eat **little** snacks.
7. I wrap presents **thus**.
8. I appreciate your **worth**.
9. I write **simply**.
10. I enjoy **southern** culture.
11. I like this **year**.
12. I **could** skate Friday.

APPENDIX L

Fall B Mid Test 1

Fall B Mid Test 1

Perception Test:

Number your paper from 1 to 12. Listen to the following words. If the word contains a /i/ sound, write 1. If the word contains a /I/ sound, write 2.

1. team
2. feel
3. research
4. simply
5. still
6. political
7. listen
8. real
9. year
10. speak
11. history
12. little

Number your paper from 1 to 12. Listen to the following words. If the word contains a /ʊ/ sound, write 1. If the word contains a /u/ sound, write 2.

1. tool
2. soon
3. wolf
4. could
5. use
6. cook
7. bush
8. goodness
9. cooking
10. student
11. lose
12. user

Number your paper from 1 to 12. Listen to the following words. If the word contains a /ð/ sound, write 1. If the word contains a /ə/ sound, write 2.

1. therefore
2. smooth
3. thus
4. mother
5. truth
6. thought
7. three
8. southern
9. growth
10. worth
11. either
12. throw

Production Test 1:

Read a word silently, then look at me and say the word before moving on.

1. come
2. goodness
3. out
4. three
5. simply
6. make
7. throw
8. team
9. feel
10. little
11. say
12. growth

Read a word silently, then look at me and say the word before moving on.

1. way
2. southern
3. year
4. tool
5. history

6. speak
7. lose
8. thus
9. therefore
10. go
11. soon
12. cook

Read a word silently, then look at me and say the word before moving on.

1. user
2. political
3. research
4. could
5. truth
6. listen
7. bush
8. use
9. smooth
10. real
11. cooking
12. take

Read a word silently, then look at me and say the word before moving on.

1. either
2. student
3. more
4. have
5. still
6. wolf
7. just
8. how
9. worth
10. mother
11. thought
12. tell

Production Test 2:

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I **lose** my mind.
2. I want more **growth**.
3. I **could** skate Friday.
4. I taste **goodness**.
5. I wrap presents **thus**.
6. I hate her **cooking**.
7. I **therefore** drink coffee.
8. I understand **history**.
9. I eat **little** snacks.
10. I move the **bush**.
11. I know a **user**.
12. I need a new **student**.

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I **still** make pies.
2. I support his **team**.
3. I drink **real** coffee.
4. I forget my **thought**.
5. I **cook** often.
6. I miss my **mother**.
7. I **speak** in tongues.
8. I **feel** every scratch.
9. I like this **year**.
10. I have **three** toes.
11. I **listen** to her.
12. I write **simply**.

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I hate **political** rhetoric.
2. I tell the **truth**.
3. I have **smooth** fabric.
4. I write great **research**.
5. I enjoy **southern** culture.

6. I **throw** tennis balls.
7. I own a **wolf**.
8. I do not love her **either**.
9. I have a **tool**.
10. I appreciate your **worth**.
11. I will jump **soon**.
12. I **use** my pencils.

APPENDIX M

Fall B Mid Test 2

Fall B Mid Test 2

Perception Test:

Number your paper from 1 to 12. Listen to the following words. If the word contains a /ð/ sound, write 1. If the word contains a /ɵ/ sound, write 2.

1. therefore
2. smooth
3. three
4. either
5. worth
6. mother
7. truth
8. throw
9. growth
10. southern
11. thus
12. thought

Number your paper from 1 to 12. Listen to the following words. If the word contains a /ʊ/ sound, write 1. If the word contains a /u/ sound, write 2.

1. bush
2. cook
3. student
4. soon
5. goodness
6. cooking
7. user
8. tool
9. could
10. lose
11. use
12. wolf

Number your paper from 1 to 12. Listen to the following words. If the word contains a /i/ sound, write 1. If the word contains a /I/ sound, write 2.

1. simply
2. history
3. real
4. little
5. research
6. speak
7. listen
8. team
9. political
10. year
11. still
12. feel

Production Test 1:

Read a word silently, then look at me and say the word before moving on.

1. smooth
2. take
3. student
4. thought
5. throw
6. goodness
7. thus
8. tell
9. therefore
10. growth
11. use
12. history

Read a word silently, then look at me and say the word before moving on.

1. go
2. three
3. simply
4. year
5. wolf

6. southern
7. truth
8. bush
9. cook
10. speak
11. real
12. have

Read a word silently, then look at me and say the word before moving on.

1. cooking
2. still
3. either
4. research
5. user
6. team
7. little
8. say
9. way
10. soon
11. just
12. more

Read a word silently, then look at me and say the word before moving on.

1. out
2. tool
3. feel
4. worth
5. lose
6. come
7. political
8. could
9. mother
10. make
11. how
12. listen

Production Test 2:

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I like this **year**.
2. I want more **growth**.
3. I understand **history**.
4. I **feel** every scratch.
5. I **lose** my mind.
6. I have **smooth** fabric.
7. I miss my **mother**.
8. I **cook** often.
9. I forget my **thought**.
10. I **use** my pencils.
11. I enjoy **southern** culture.
12. I have a **tool**.

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I support his **team**.
2. I **listen** to her.
3. I **throw** tennis balls.
4. I write **simply**.
5. I move the **bush**.
6. I hate **political** rhetoric.
7. I tell the **truth**.
8. I do not love her **either**.
9. I need a new **student**.
10. I taste **goodness**.
11. I **could** skate Friday.
12. I eat **little** snacks.

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I **speak** in tongues.
2. I will jump **soon**.
3. I drink **real** coffee.
4. I **still** make pies
5. I appreciate your **worth**.

6. I wrap presents **thus**.
7. I **therefore** drink coffee.
8. I know a **user**.
9. I write great **research**.
10. I own a **wolf**.
11. I hate her **cooking**.
12. I have **three** toes.

APPENDIX N

Fall B Post Test

Fall B Post Test

Perception Test:

Number your paper from 1 to 12. Listen to the following words. If the word contains a /ð/ sound, write 1. If the word contains a /ɵ/ sound, write 2.

1. southern
2. thus
3. three
4. truth
5. either
6. growth
7. throw
8. worth
9. thought
10. mother
11. smooth
12. therefore

Number your paper from 1 to 12. Listen to the following words. If the word contains a /i/ sound, write 1. If the word contains a /I/ sound, write 2.

1. year
2. little
3. speak
4. real
5. research
6. still
7. listen
8. political
9. feel
10. simply
11. team
12. history

Number your paper from 1 to 12. Listen to the following words. If the word contains a /ʊ/ sound, write 1. If the word contains a /u/ sound, write 2.

1. bush
2. wolf
3. user
4. lose
5. cook
6. student
7. use
8. could
9. tool
10. goodness
11. cooking
12. soon

Production Test 1:

Read a word silently, then look at me and say the word before moving on.

1. growth
2. smooth
3. soon
4. have
5. three
6. go
7. cook
8. real
9. still
10. how
11. mother
12. goodness

Read a word silently, then look at me and say the word before moving on.

1. therefore
2. history
3. tool
4. year
5. either

6. take
7. throw
8. student
9. thus
10. lose
11. little
12. team

Read a word silently, then look at me and say the word before moving on.

1. simply
2. thought
3. just
4. user
5. research
6. speak
7. wolf
8. feel
9. out
10. listen
11. make
12. more

Read a word silently, then look at me and say the word before moving on.

1. say
2. worth
3. use
4. way
5. tell
6. bush
7. cooking
8. could
9. southern
10. come
11. political
12. truth

Production Test 2:

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I own a **wolf**.
2. I forget my **thought**.
3. I need a new **student**.
4. I like this **year**.
5. I hate her **cooking**.
6. I know a **user**.
7. I have **smooth** fabric.
8. I move the **bush**.
9. I enjoy **southern** culture.
10. I taste **goodness**.
11. I wrap presents **thus**.
12. I do not love her **either**.

Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I understand **history**.
2. I will jump **soon**.
3. I **listen** to her.
4. I **could** skate Friday.
5. I **still** make pies
6. I **lose** my mind.
7. I have a **tool**.
8. I **use** my pencils.
9. I drink **real** coffee.
10. I miss my **mother**.
11. I support his **team**.
12. I tell the **truth**.

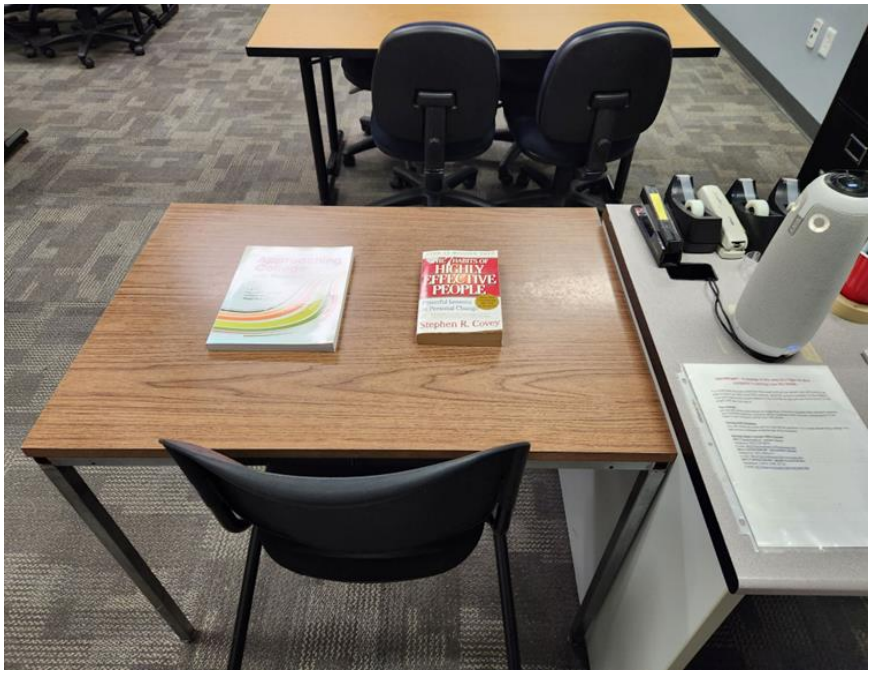
Read a sentence silently, then look at me and say the sentence before moving on. Pronounce the bolded word with the most stress.

1. I **feel** every scratch.
2. I **cook** often.
3. I write great **research**.
4. I have **three** toes.
5. I appreciate your **worth**.

6. I eat **little** snacks.
7. I **throw** tennis balls.
8. I want more **growth**.
9. I **speak** in tongues.
10. I hate **political** rhetoric.
11. I write **simply**.
12. I **therefore** drink coffee.

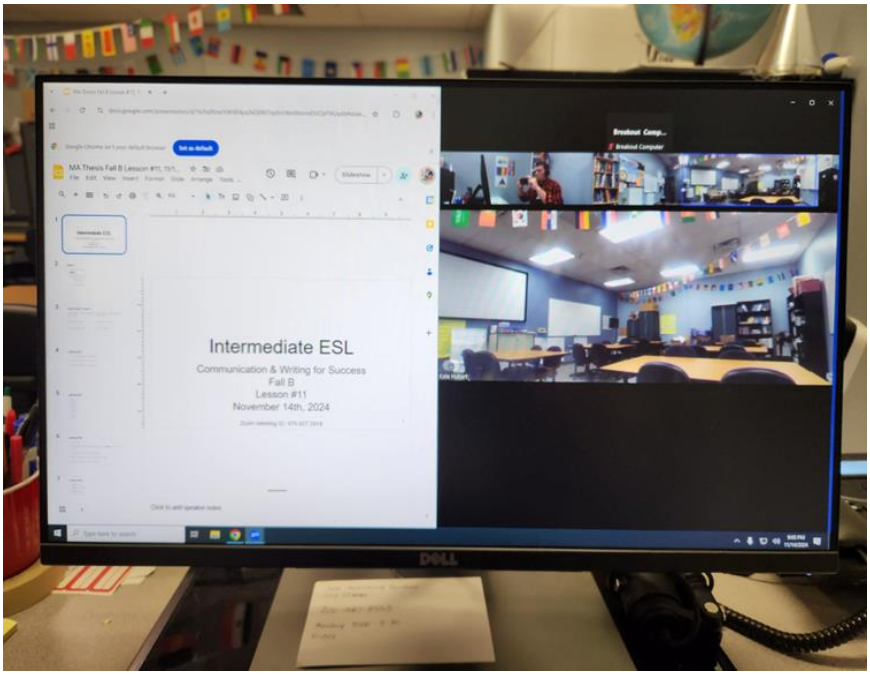
APPENDIX O

Classroom and Apparatus Photos



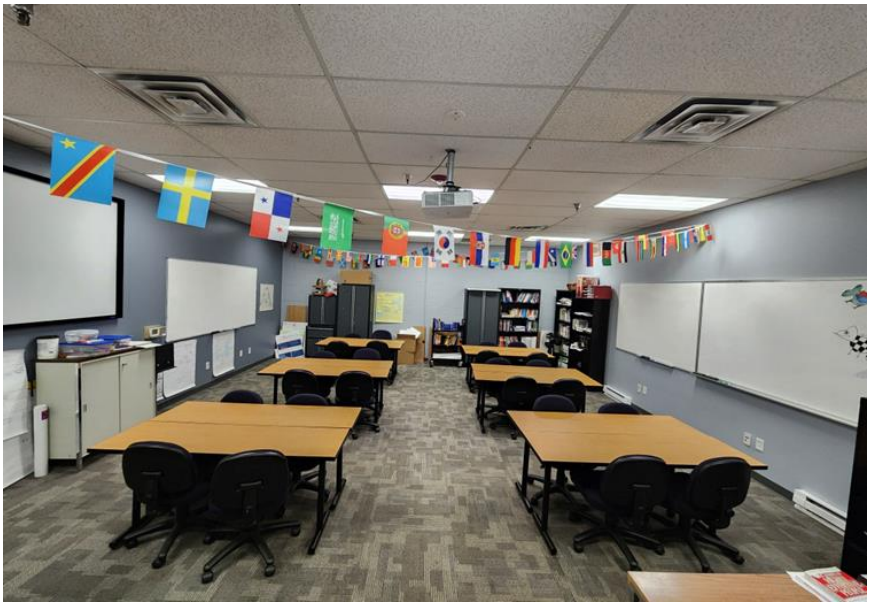
Read aloud desk.

Owl camera, microphone, and speaker system.

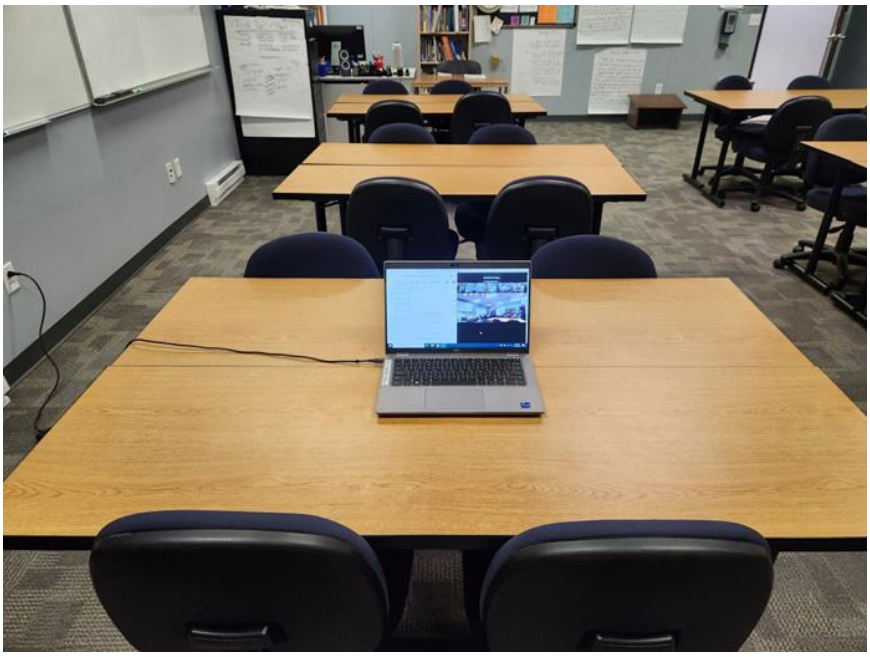


Teacher and digital management station.

Projection screen and whiteboard with dedicated camera.



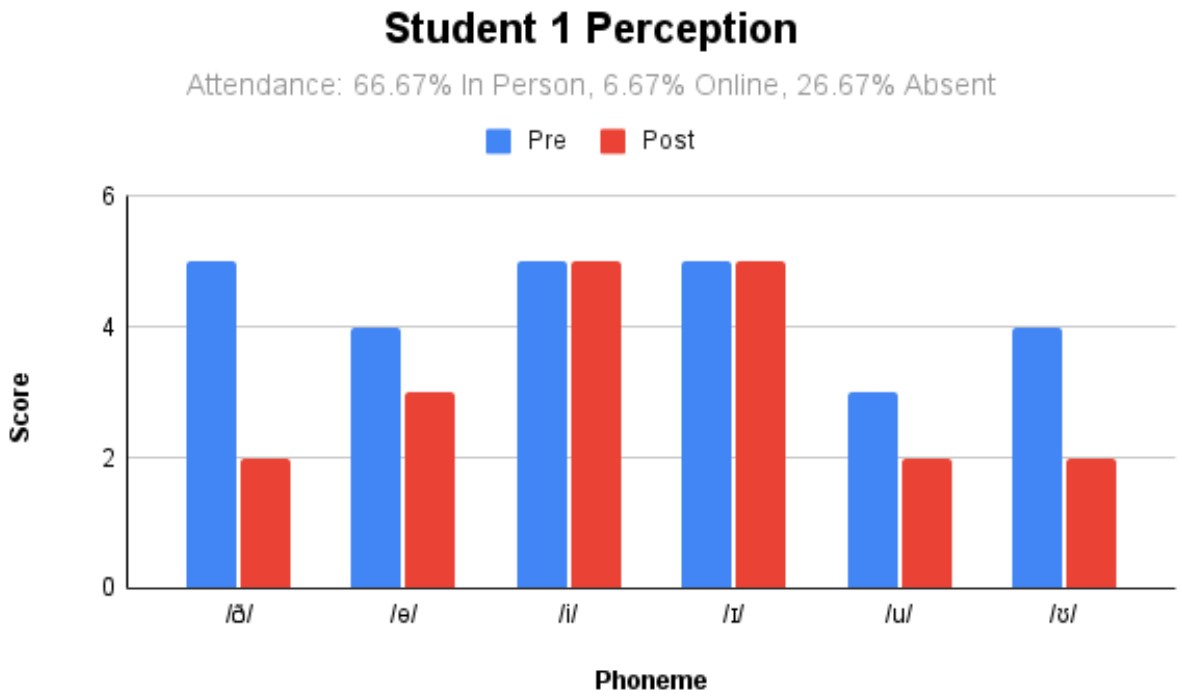
Entire classroom layout.

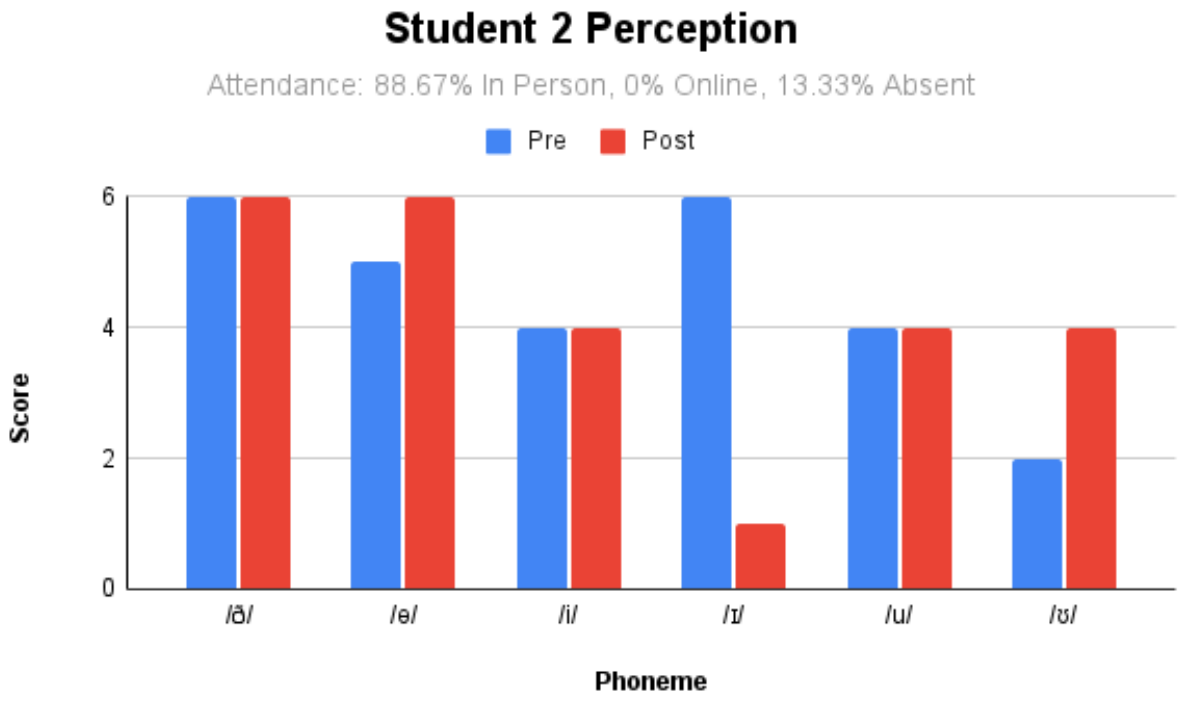


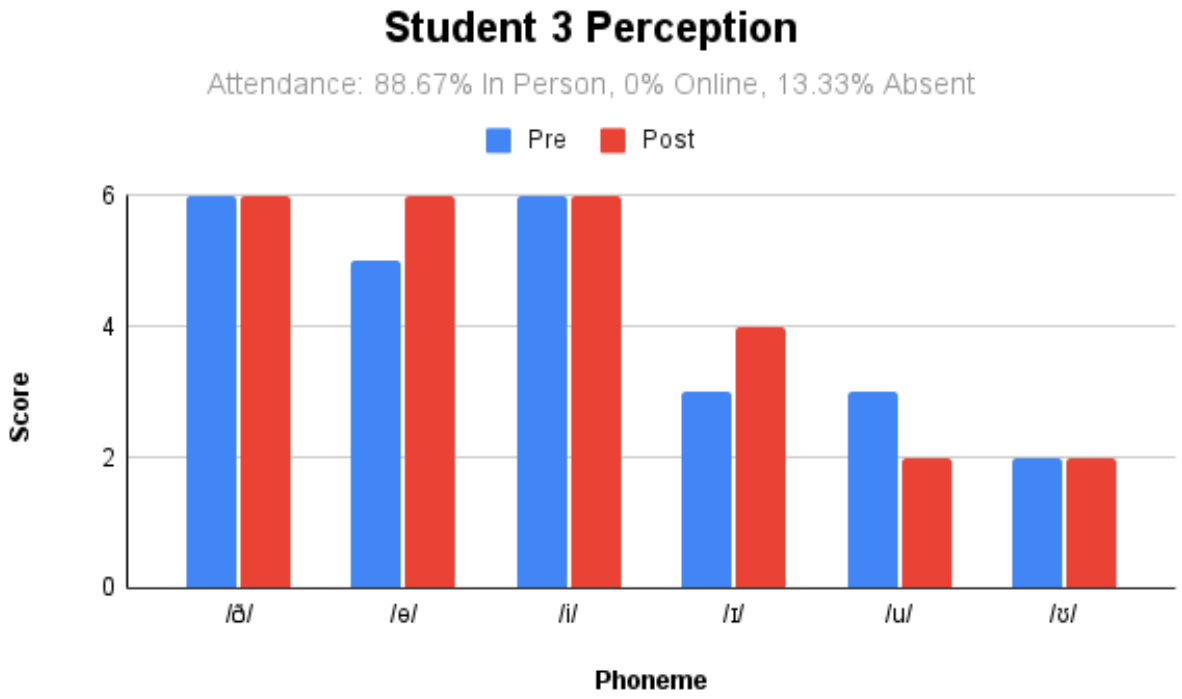
Dedicated cross modality interaction station.

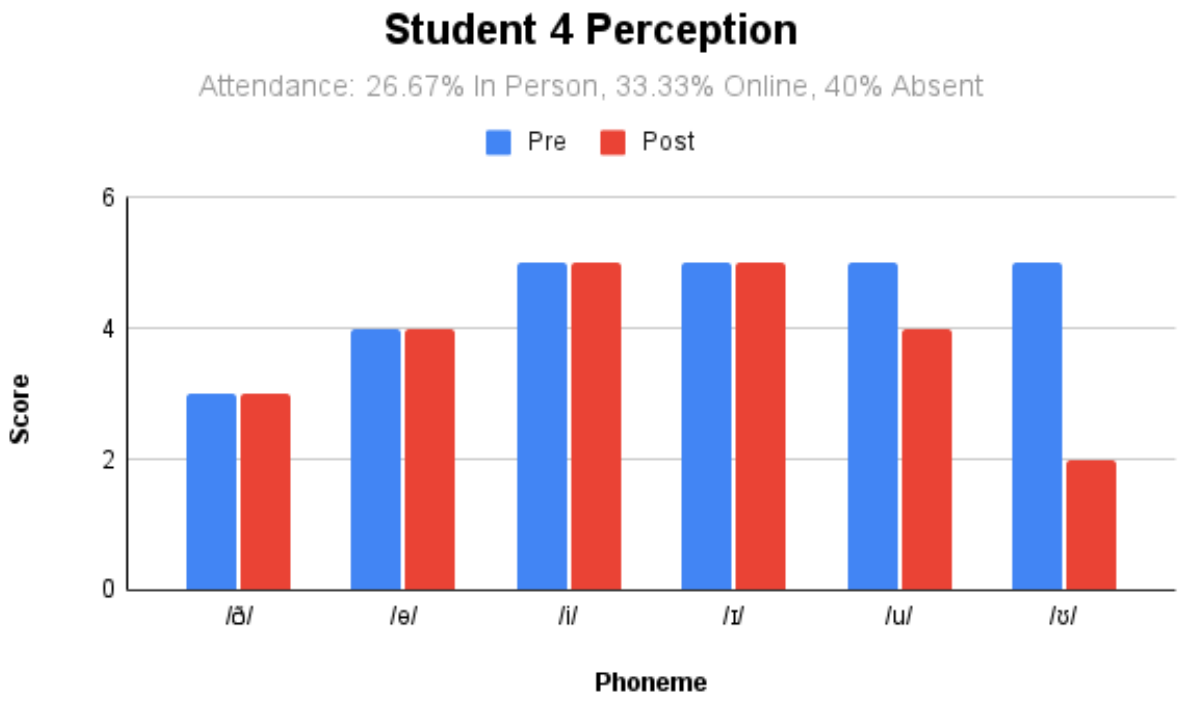
APPENDIX P

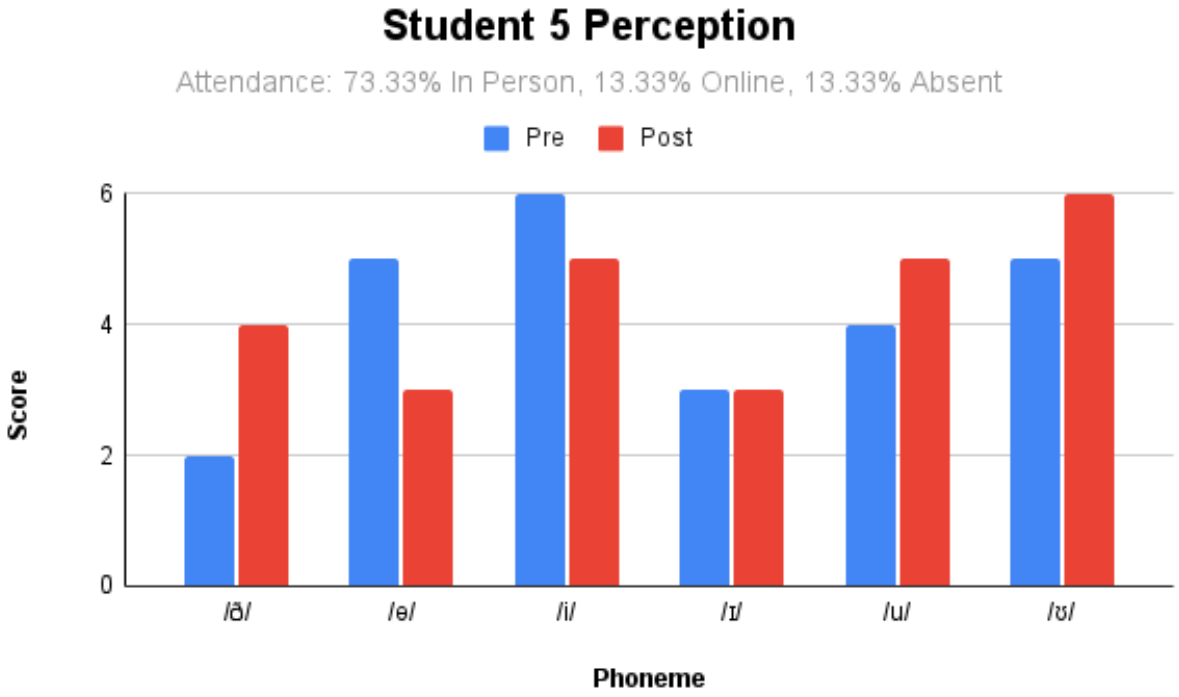
Student Perception Graphs

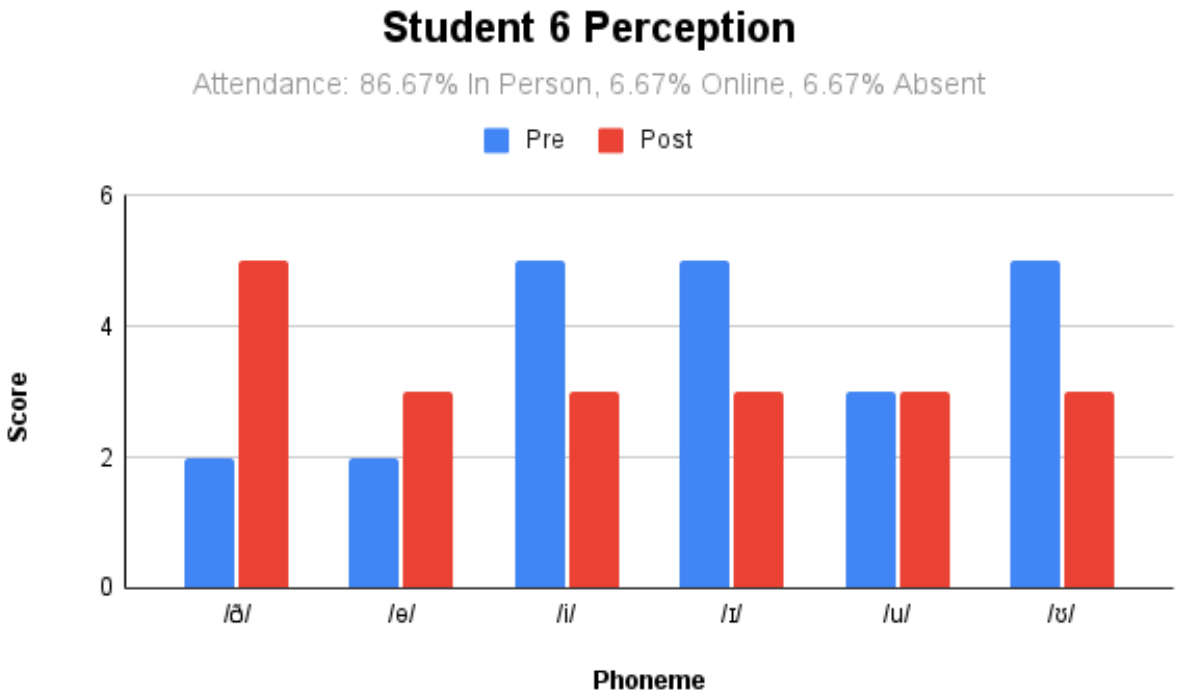


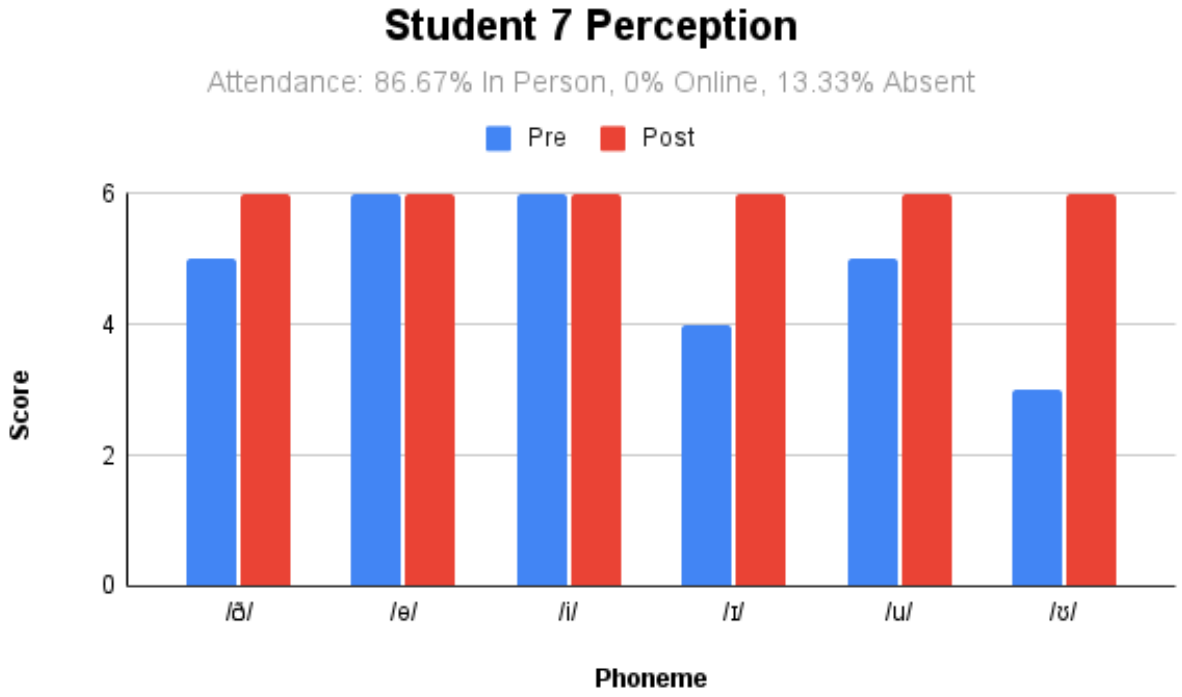


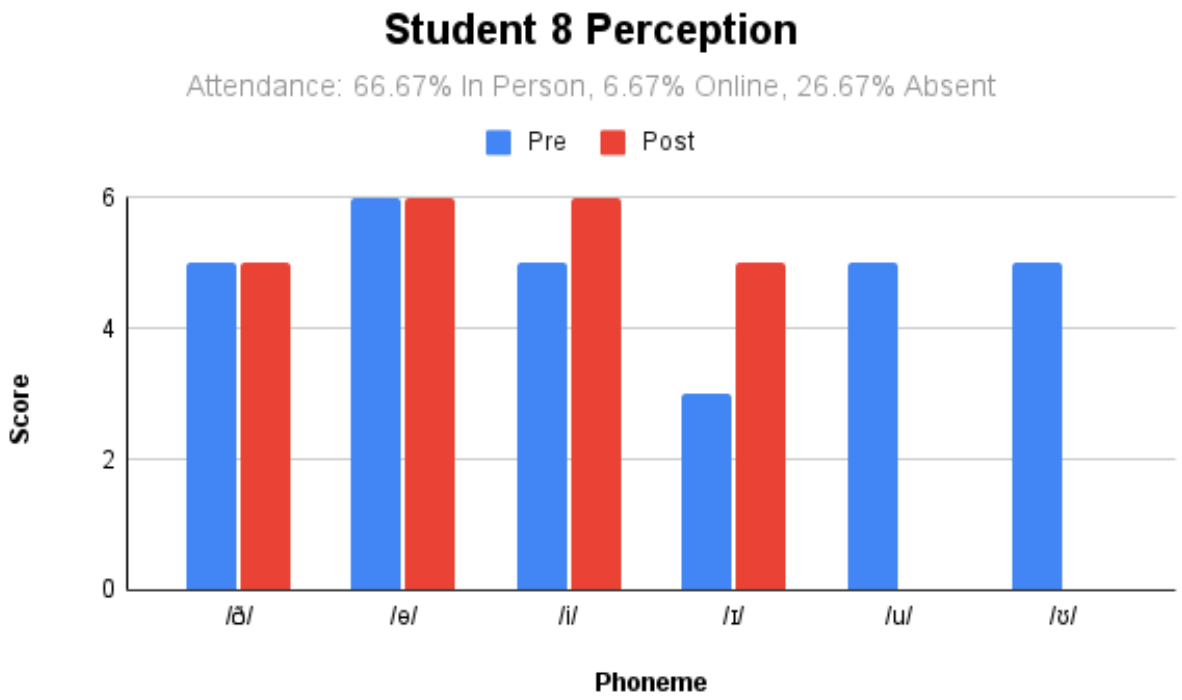

Student 3 Perception
Attendance: 88.67% In Person, 0% Online, 13.33% Absent
Pre
Post
Score
6
4
2
0
/ð/
/ɵ/
/i/
/ɪ/
/u/
/ʊ/
Phoneme

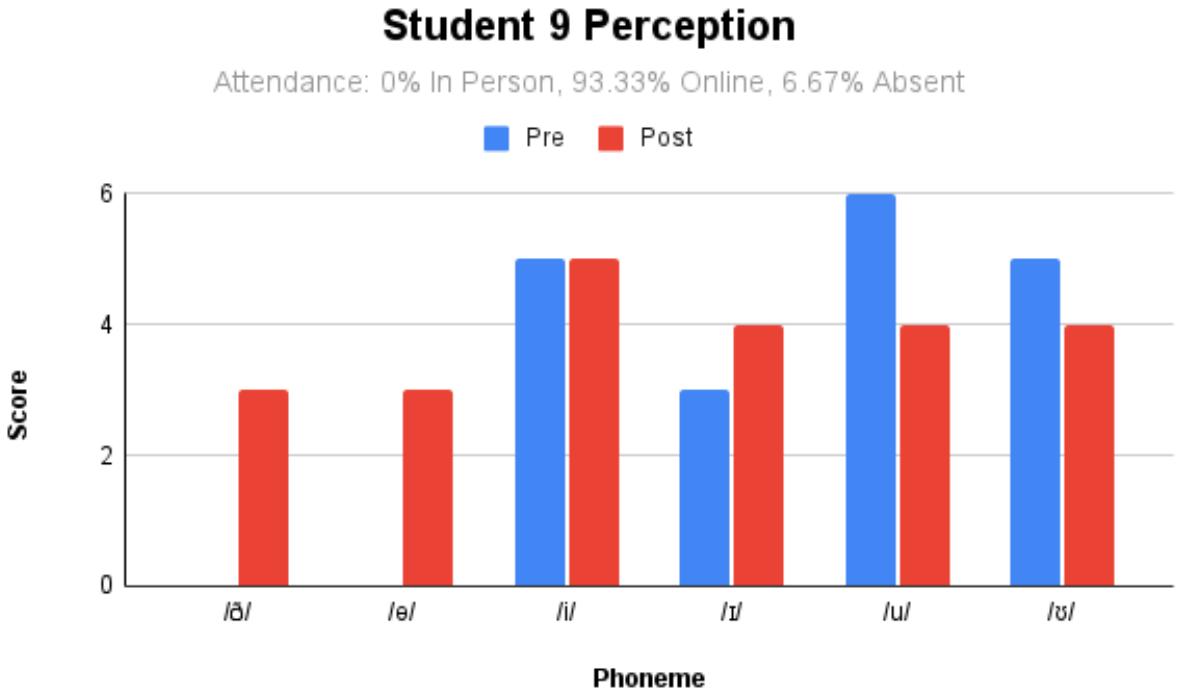

Student 4 Perception
Attendance: 26.67% In Person, 33.33% Online, 40% Absent
Pre
Post
Score
6
4
2
0
/ð/
/ɵ/
/i/
/ɪ/
/u/
/ʊ/
Phoneme


Student 5 Perception
Attendance: 73.33% In Person, 13.33% Online, 13.33% Absent
Pre
Post
Score
6
4
2
0
/ð/
/ə/
/i/
/ɪ/
/u/
/ʊ/
Phoneme


Student 6 Perception
Attendance: 86.67% In Person, 6.67% Online, 6.67% Absent
Pre
Post
Score
6
4
2
0
/ð/
/ə/
/i/
/ɪ/
/u/
/ʊ/
Phoneme

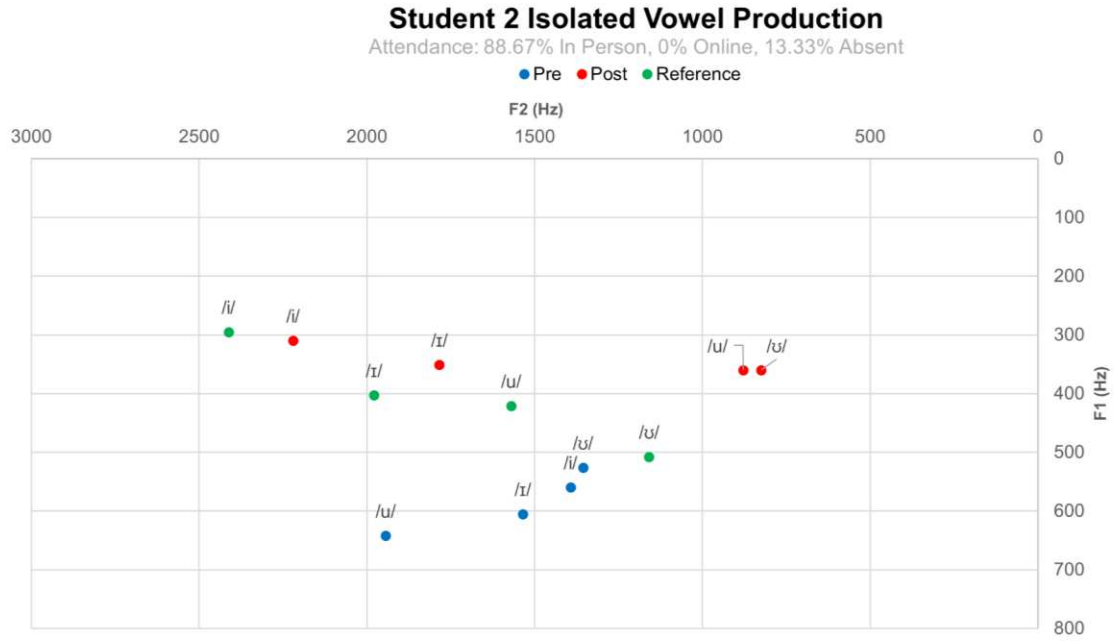

Student 7 Perception
Attendance: 86.67% In Person, 0% Online, 13.33% Absent
Pre
Post
Score
6
4
2
0
/ð/
/ə/
/i/
/ɪ/
/u/
/ʊ/
Phoneme

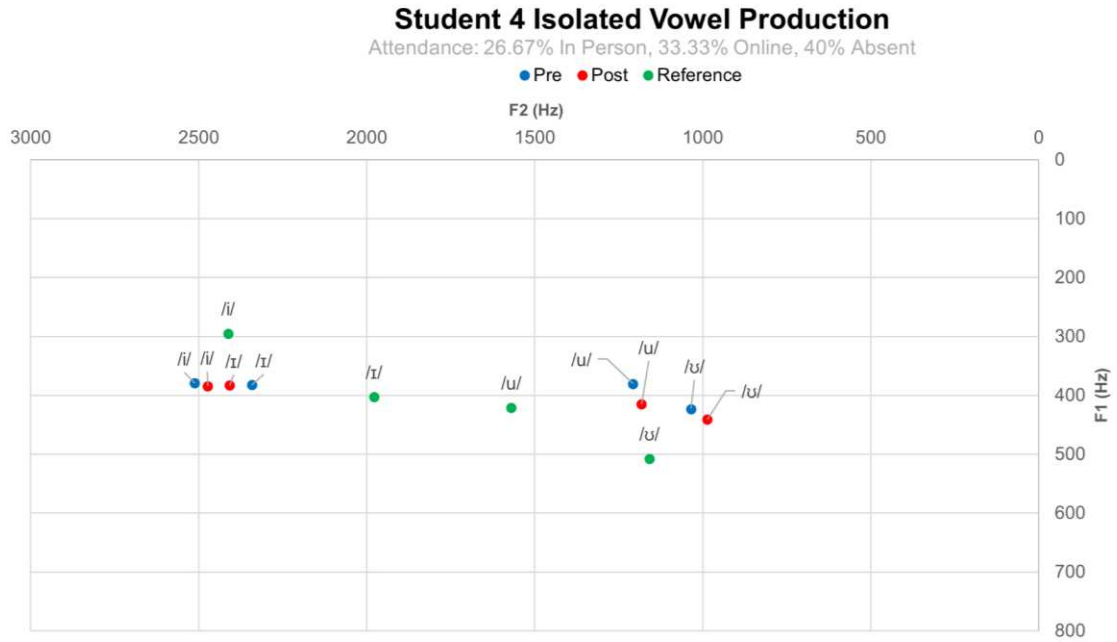

Student 8 Perception
Attendance: 66.67% In Person, 6.67% Online, 26.67% Absent
Pre
Post
Score
6
4
2
0
/ð/
/ə/
/i/
/ɪ/
/u/
/ʊ/
Phoneme

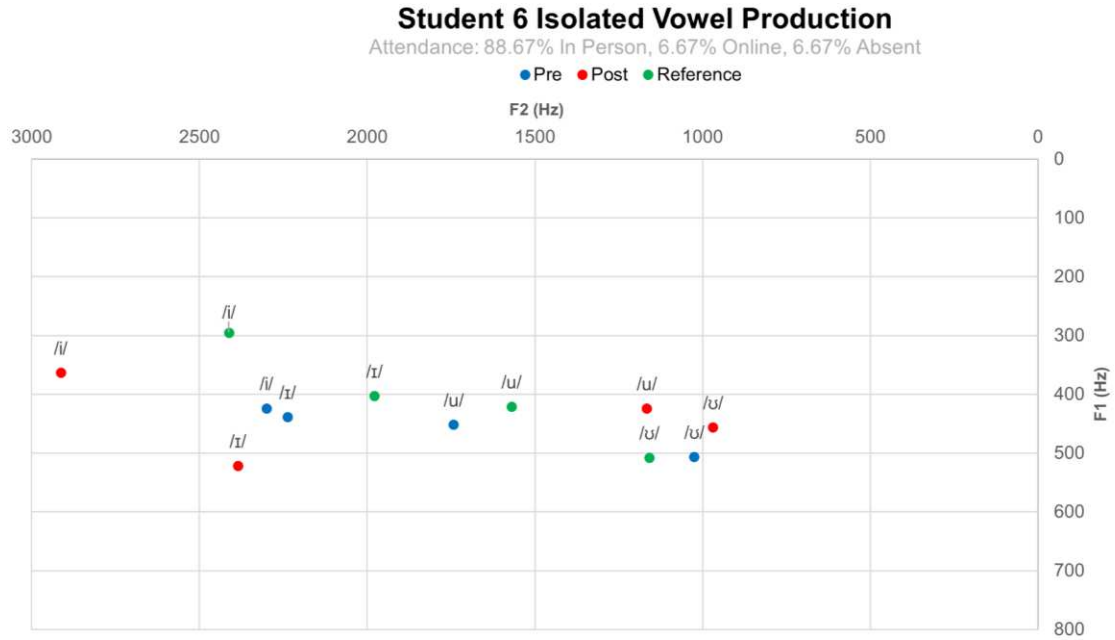

Student 9 Perception
Attendance: 0% In Person, 93.33% Online, 6.67% Absent
Pre
Post
Score
6
4
2
0
/ð/
/ə/
/i/
/ɪ/
/u/
/ʊ/
Phoneme

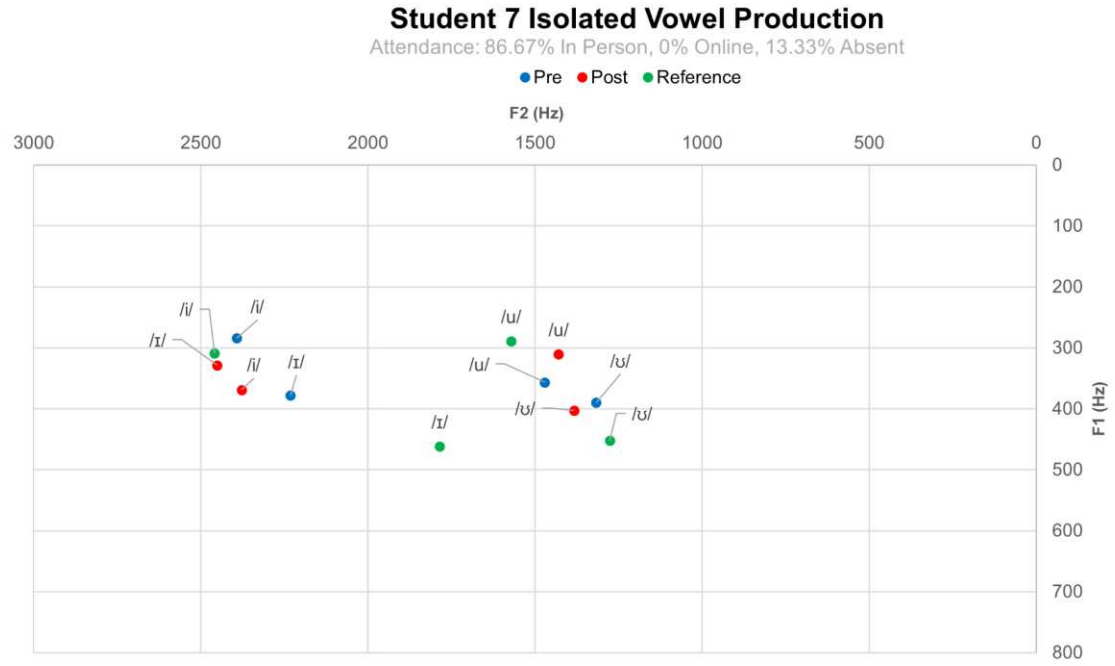
APPENDIX Q

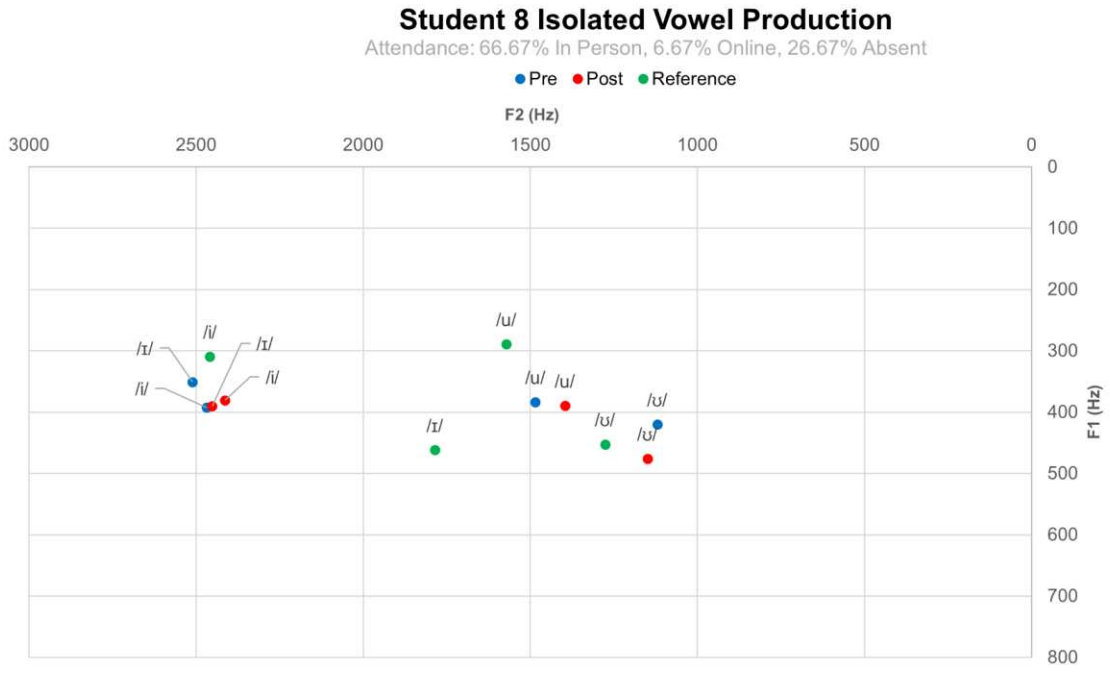
Student Isolated Vowel Production Graphs





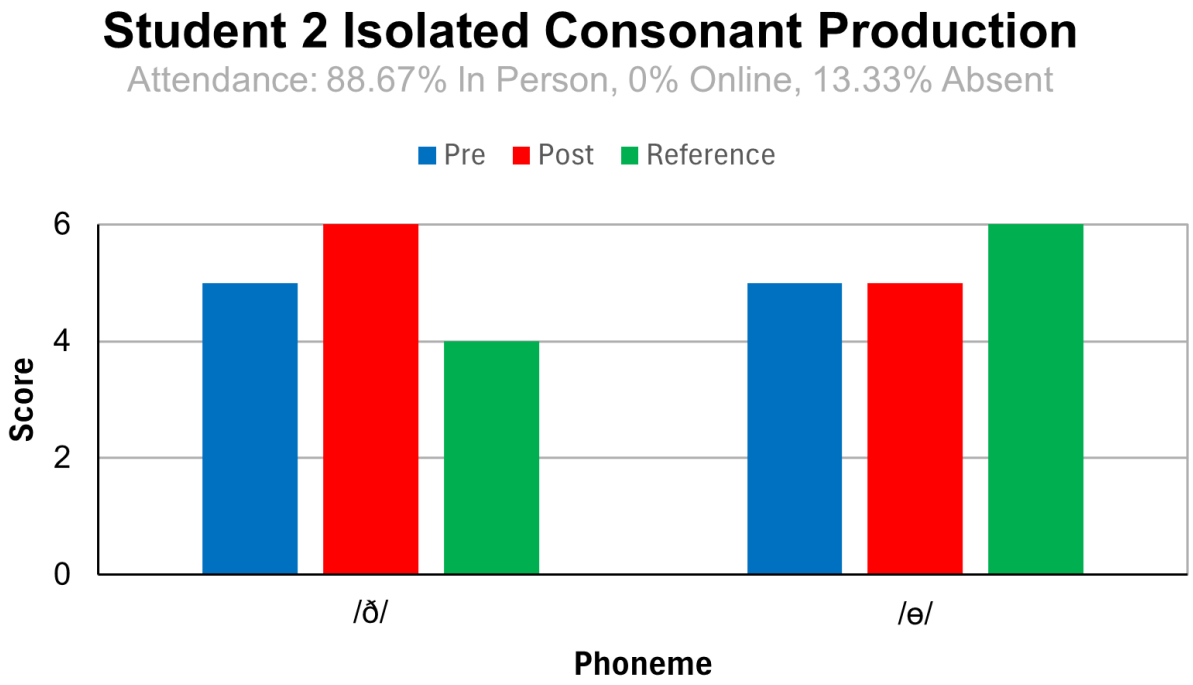

Student 6 Isolated Vowel Production
Attendance: 88.67% In Person, 6.67% Online, 6.67% Absent
Pre
Post
Reference
F2 (Hz)
3000
2500
2000
1500
1000
500
0
F1 (Hz)
0
100
200
300
400
500
600
700
800
/i/
/ɪ/
/u/
/ʊ/

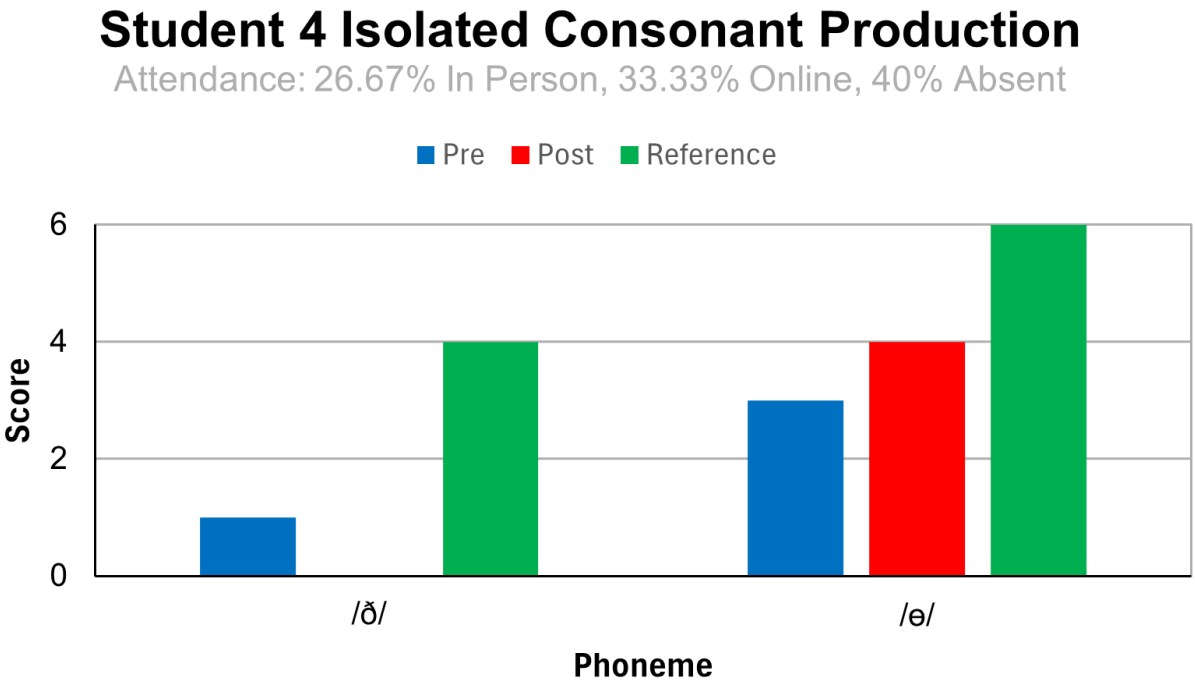

Student 7 Isolated Vowel Production
Attendance: 86.67% In Person, 0% Online, 13.33% Absent
Pre
Post
Reference
F2 (Hz)
3000
2500
2000
1500
1000
500
0
F1 (Hz)
0
100
200
300
400
500
600
700
800
/i/
/ɪ/
/u/
/ʊ/

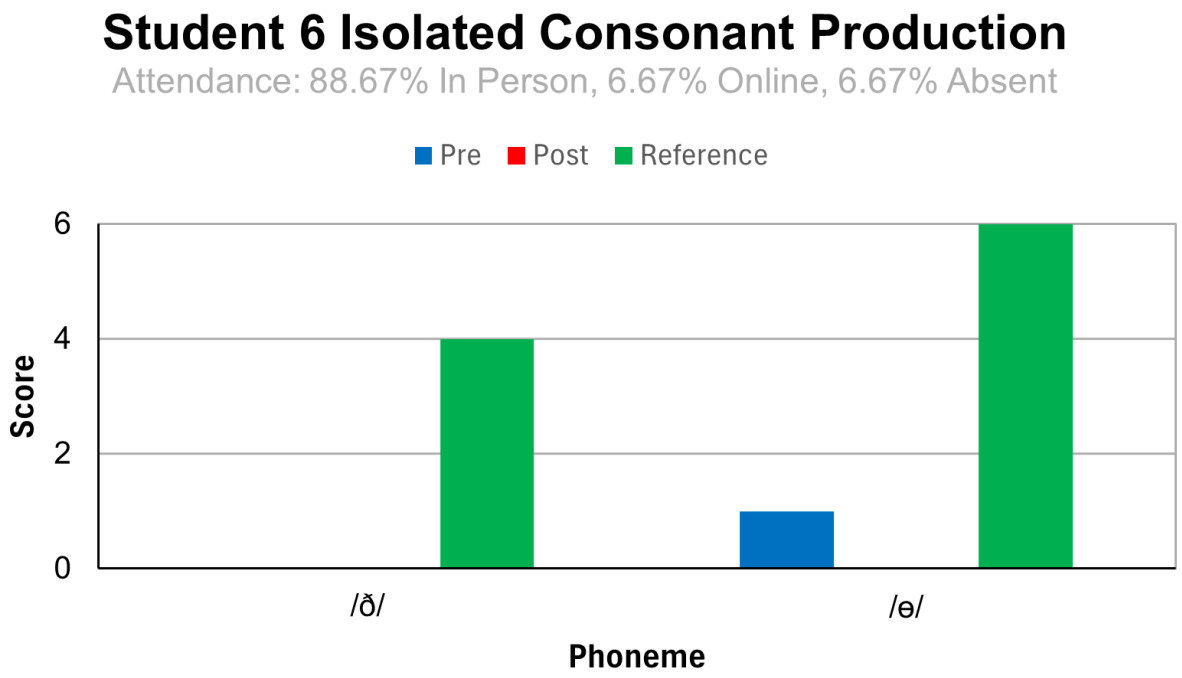

Student 8 Isolated Vowel Production
Attendance: 66.67% In Person, 6.67% Online, 26.67% Absent
Pre
Post
Reference
F2 (Hz)
3000
2500
2000
1500
1000
500
0
F1 (Hz)
0
100
200
300
400
500
600
700
800
/ɪ/
/i/
/ɪ/
/i/
/i/
/ɪ/
/ʊ/
/ʊ/
/ʊ/
/ʊ/
/ʊ/
/ʊ/

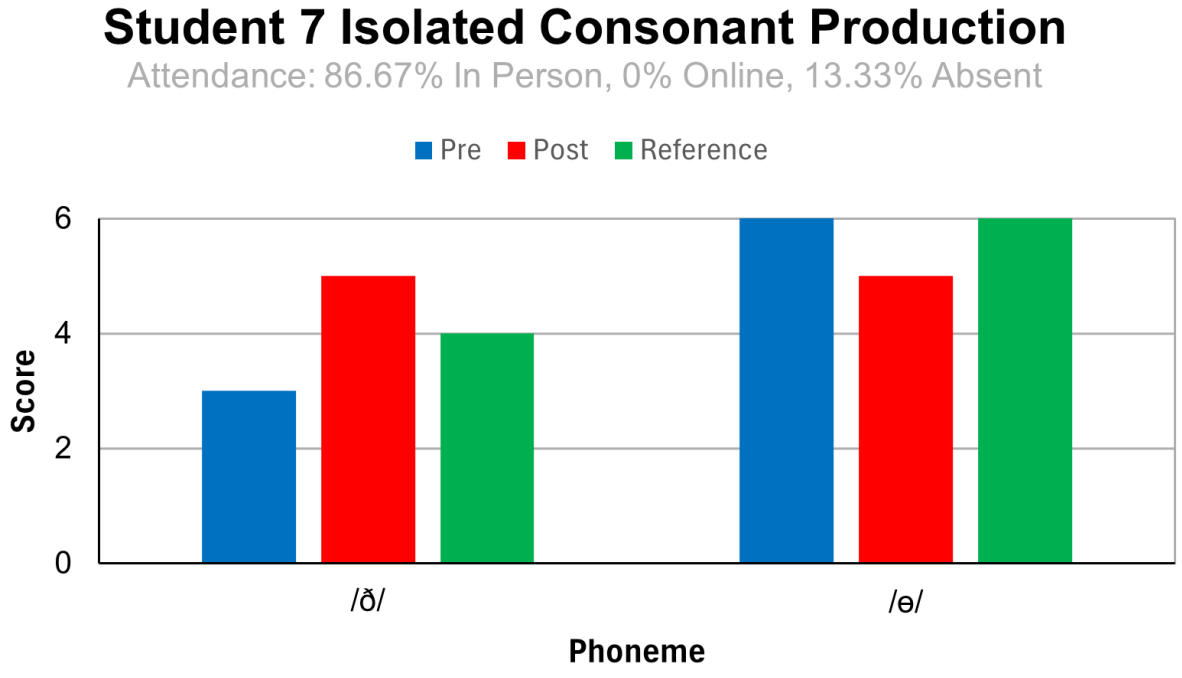
APPENDIX R

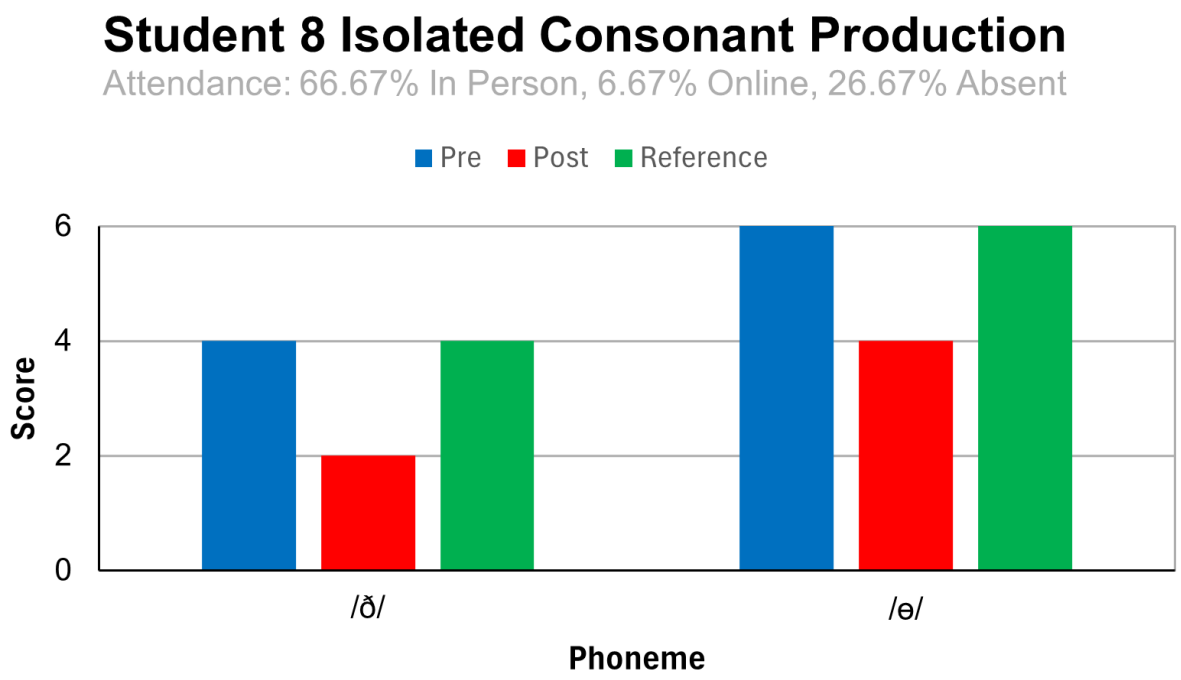
Student Isolated Consonant Production Graphs





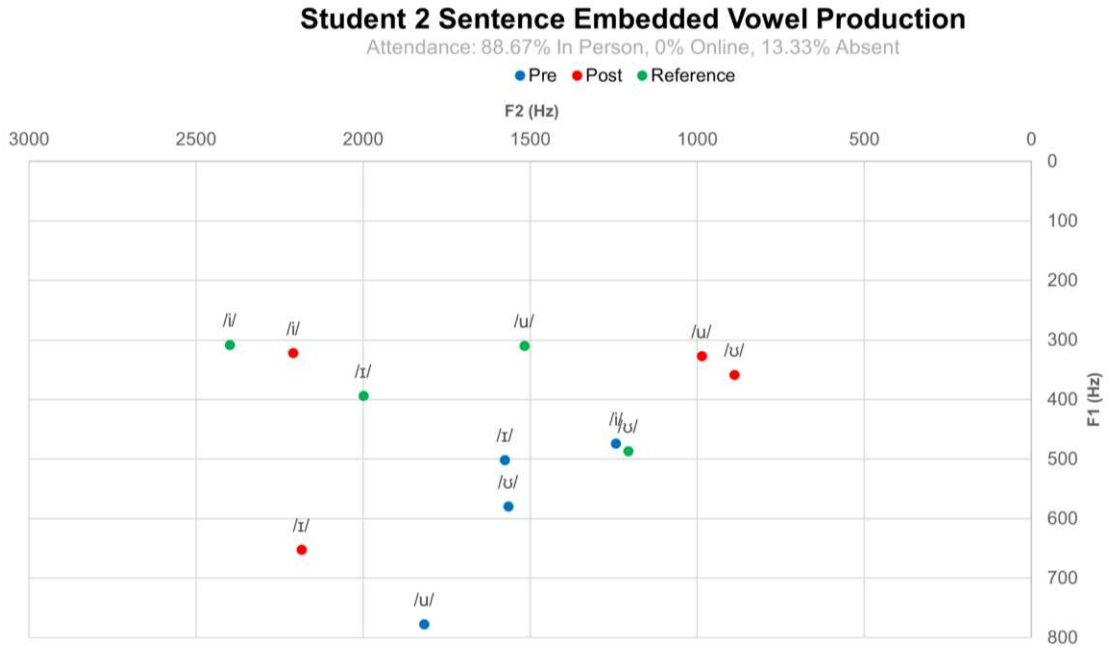

Student 6 Isolated Consonant Production
Attendance: 88.67% In Person, 6.67% Online, 6.67% Absent
Pre
Post
Reference
6
4
2
0
Score
/ð/
/ɵ/
Phoneme

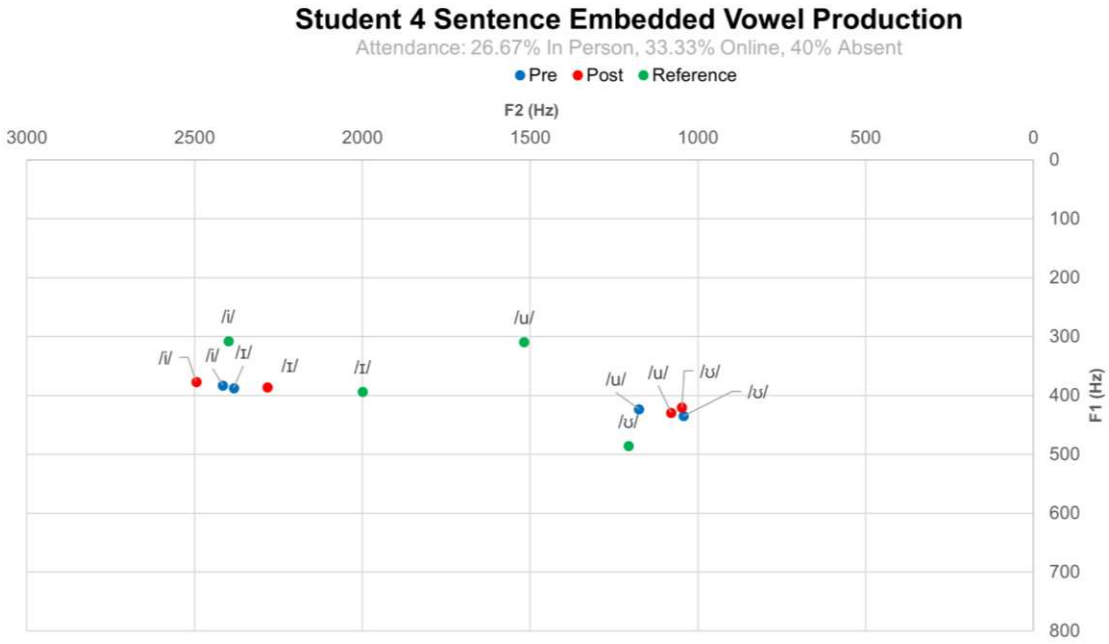

Student 7 Isolated Consonant Production
Attendance: 86.67% In Person, 0% Online, 13.33% Absent
Pre
Post
Reference
6
4
2
0
Score
/ð/
/ɵ/
Phoneme

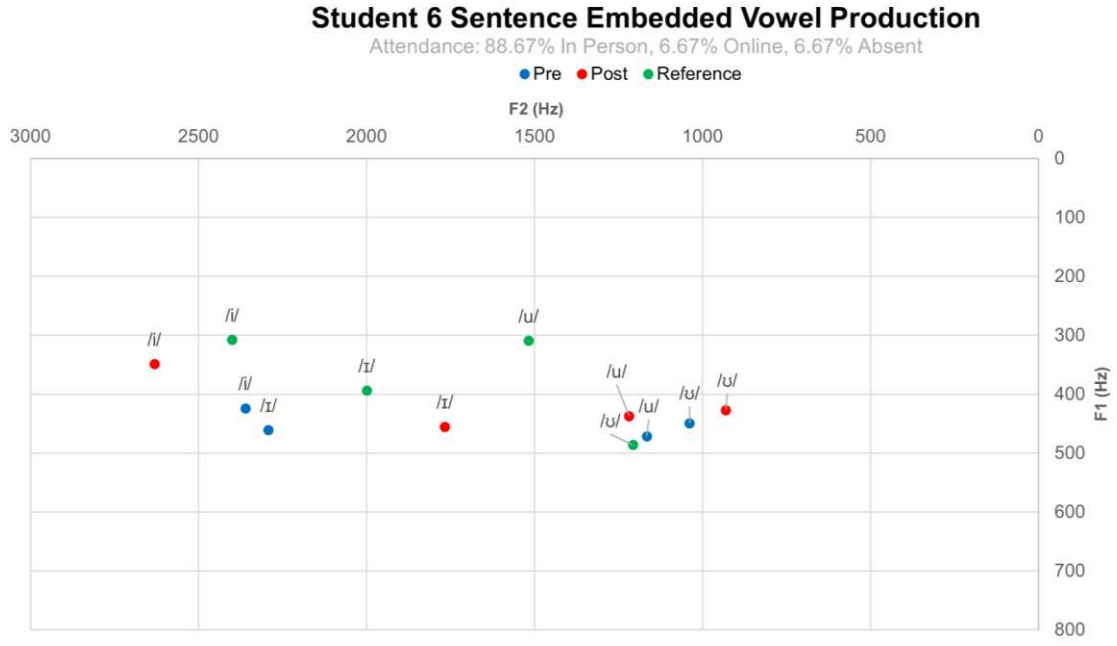

Student 8 Isolated Consonant Production
Attendance: 66.67% In Person, 6.67% Online, 26.67% Absent
Pre
Post
Reference
6
4
2
0
Score
/ð/
/ɵ/
Phoneme

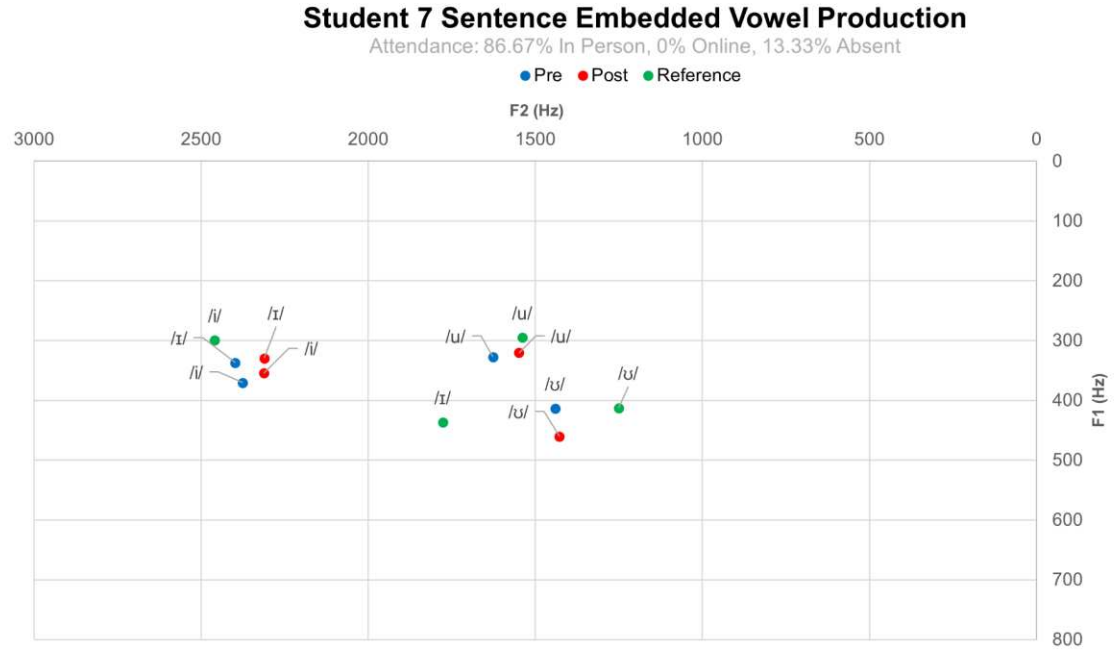
APPENDIX S

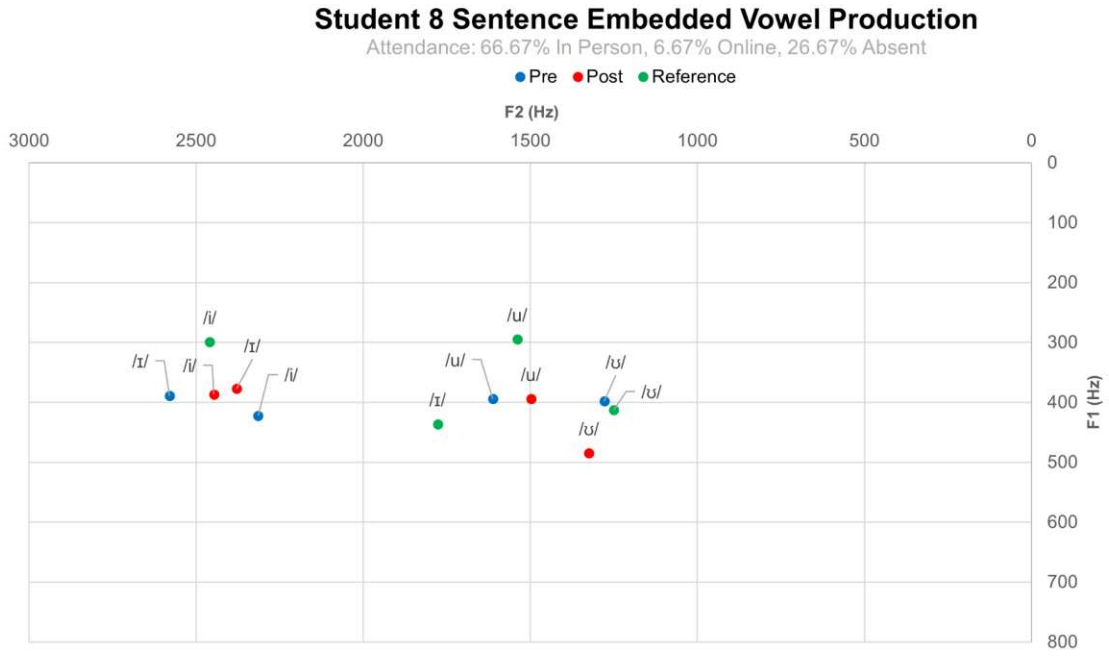
Student Sentence Embedded Vowel Production Graphs





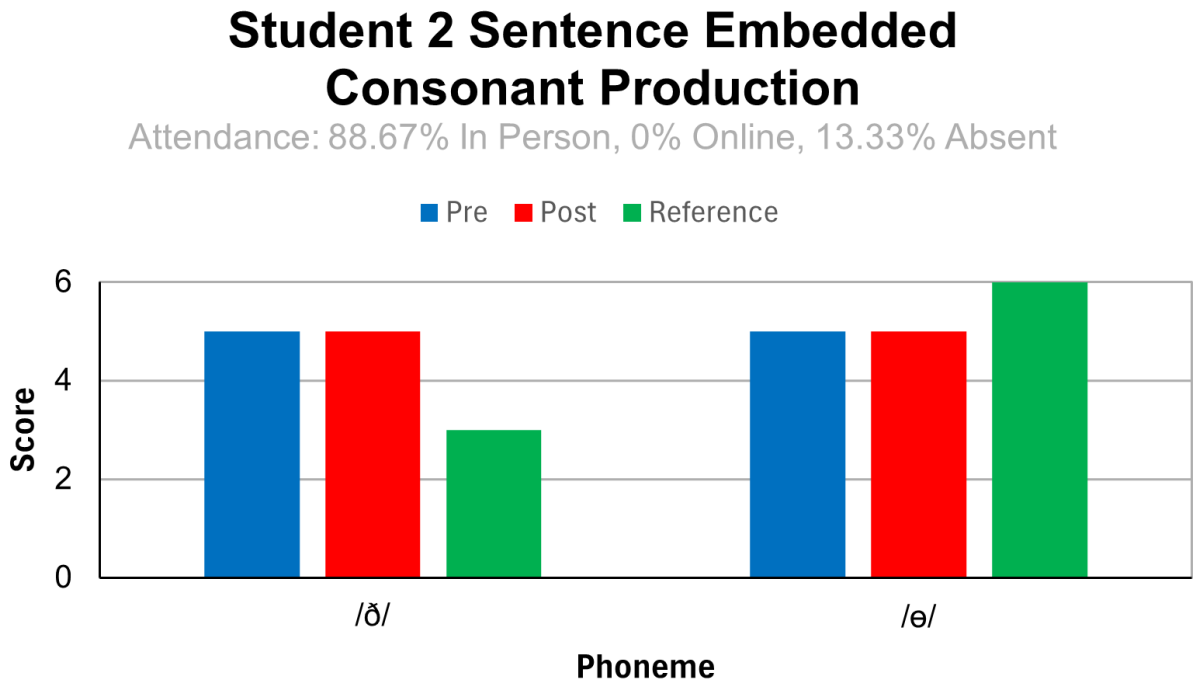

Student 6 Sentence Embedded Vowel Production
Attendance: 88.67% In Person, 6.67% Online, 6.67% Absent
Pre
Post
Reference
F2 (Hz)
3000
2500
2000
1500
1000
500
0
F1 (Hz)
0
100
200
300
400
500
600
700
800
/i/
/ɪ/
/u/
/ʊ/

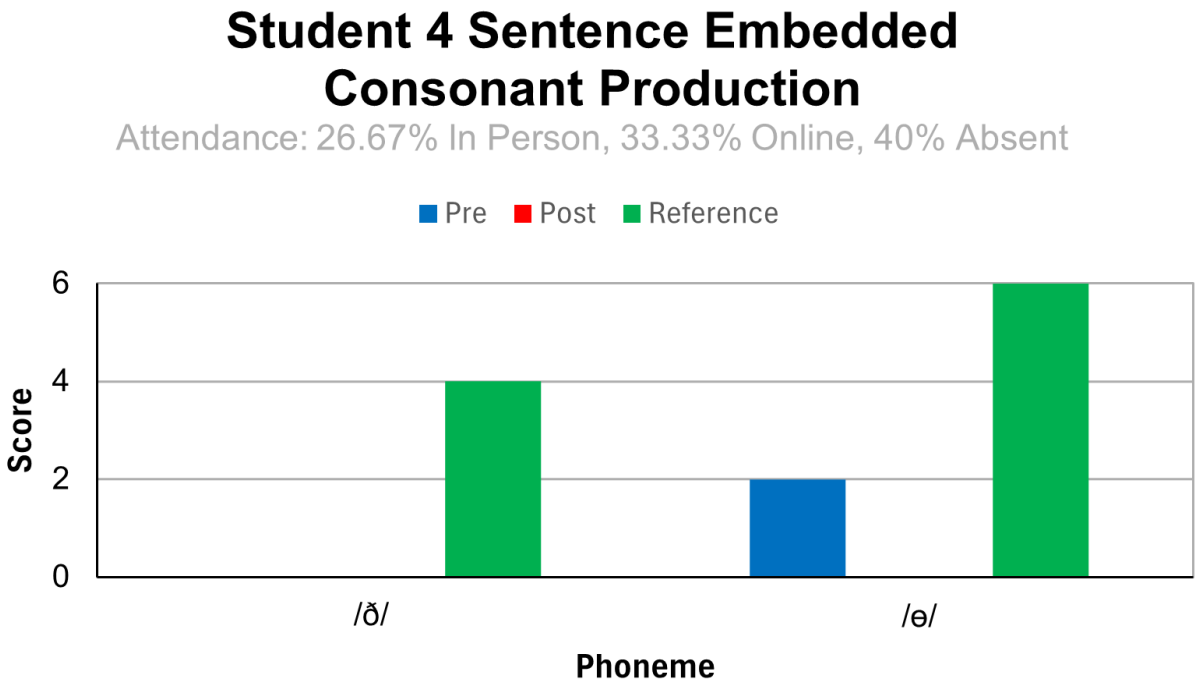

Student 7 Sentence Embedded Vowel Production
Attendance: 86.67% In Person, 0% Online, 13.33% Absent
Pre
Post
Reference
F2 (Hz)
3000
2500
2000
1500
1000
500
0
F1 (Hz)
0
100
200
300
400
500
600
700
800
/i/
/ɪ/
/u/
/ʊ/


Student 8 Sentence Embedded Vowel Production
Attendance: 66.67% In Person, 6.67% Online, 26.67% Absent
Pre
Post
Reference
F2 (Hz)
3000
2500
2000
1500
1000
500
0
F1 (Hz)
0
100
200
300
400
500
600
700
800
/i/
/ɪ/
/i/
/ɪ/
/i/
/ɪ/
/u/
/u/
/u/
/ʊ/
/ʊ/
/ʊ/

APPENDIX T

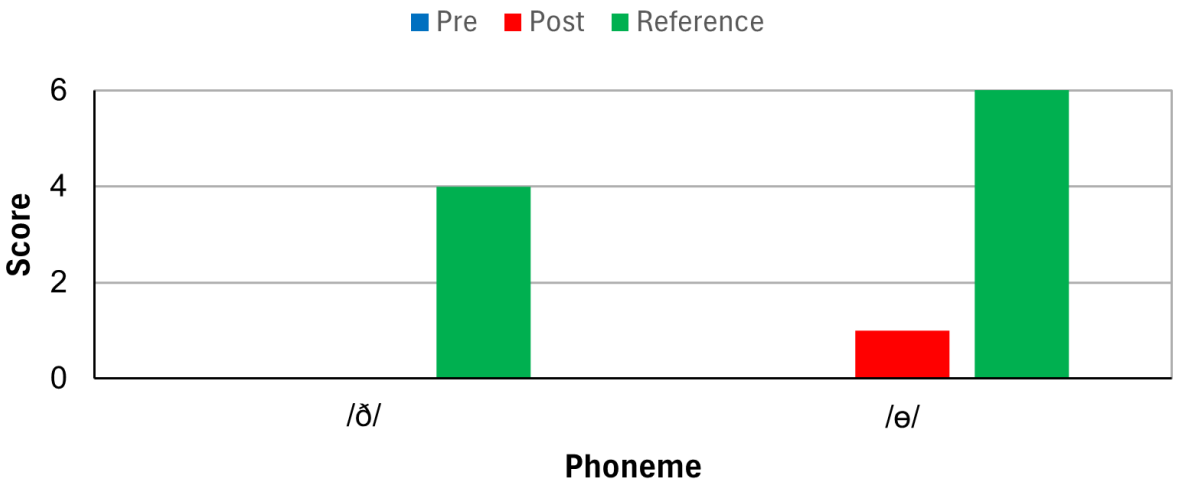
Student Sentence Embedded Consonant Production Graphs





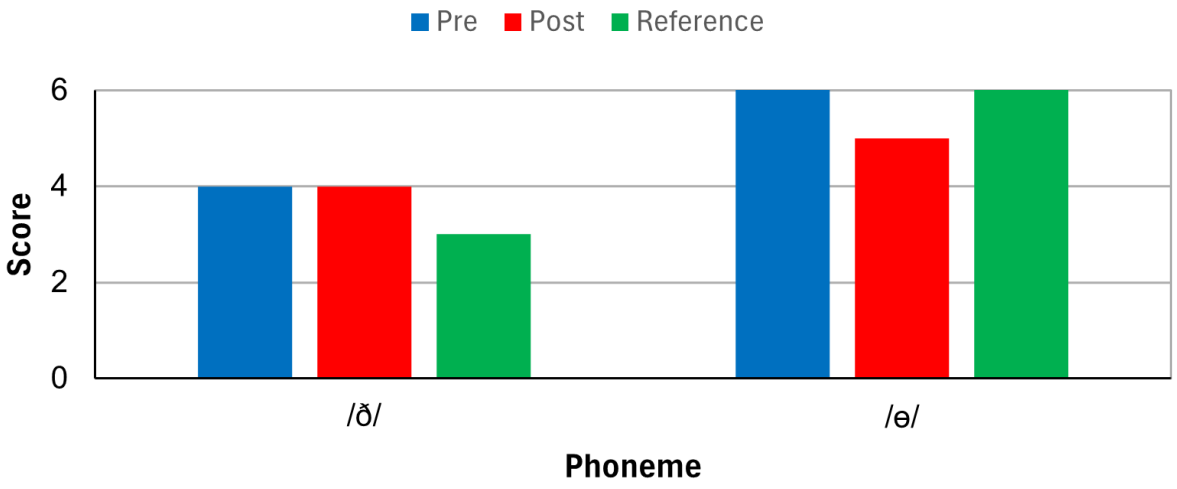
Student 6 Sentence Embedded Consonant Production

Attendance: 88.67% In Person, 6.67% Online, 6.67% Absent



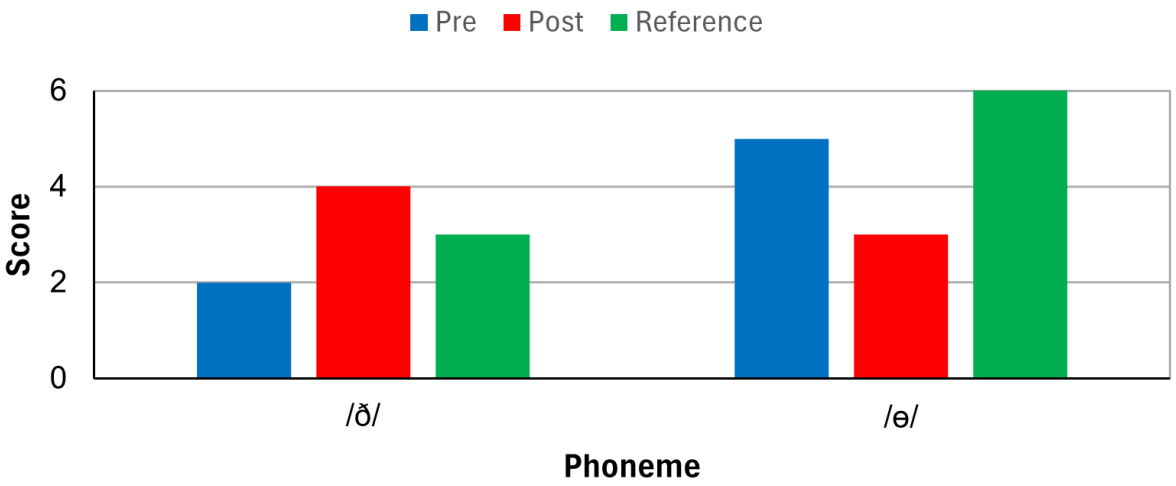
Student 7 Sentence Embedded Consonant Production

Attendance: 86.67% In Person, 0% Online, 13.33% Absent



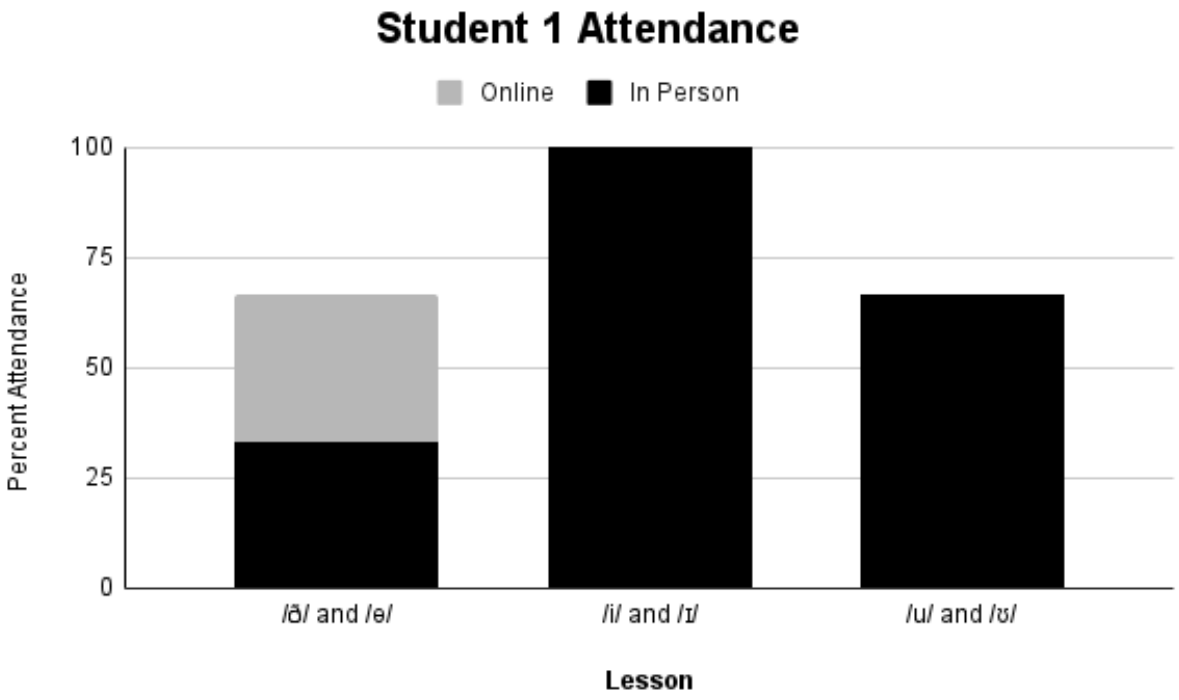
Student 8 Sentence Embedded Consonant Production

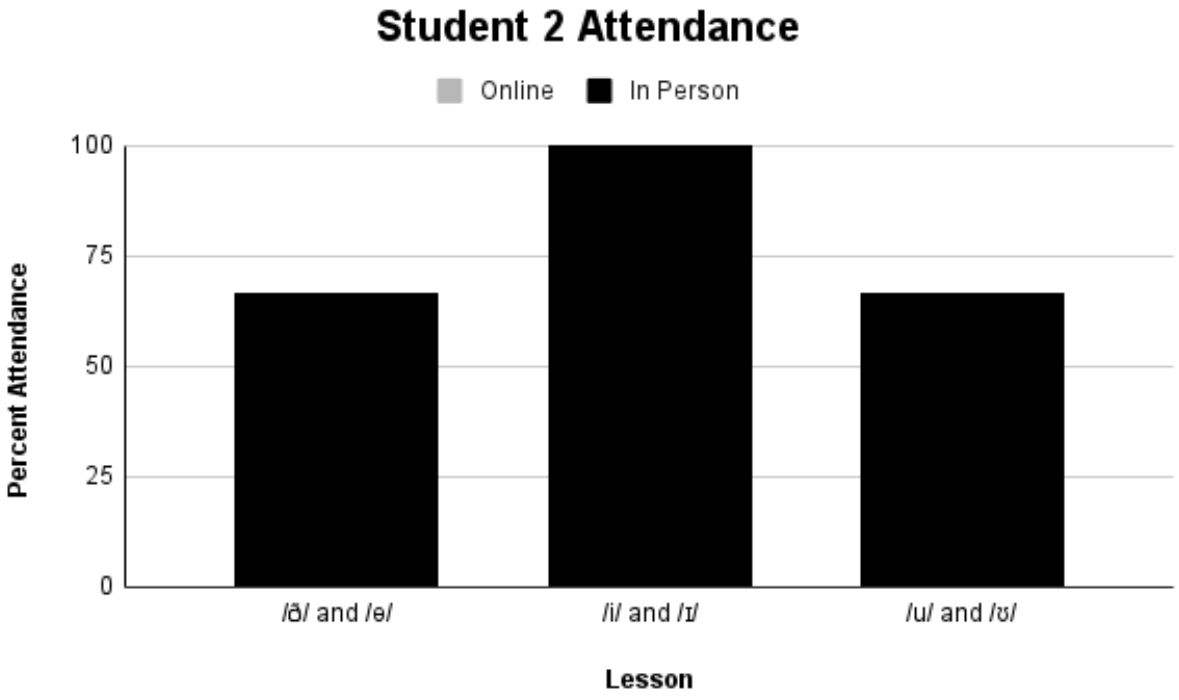
Attendance: 66.67% In Person, 6.67% Online, 26.67% Absent

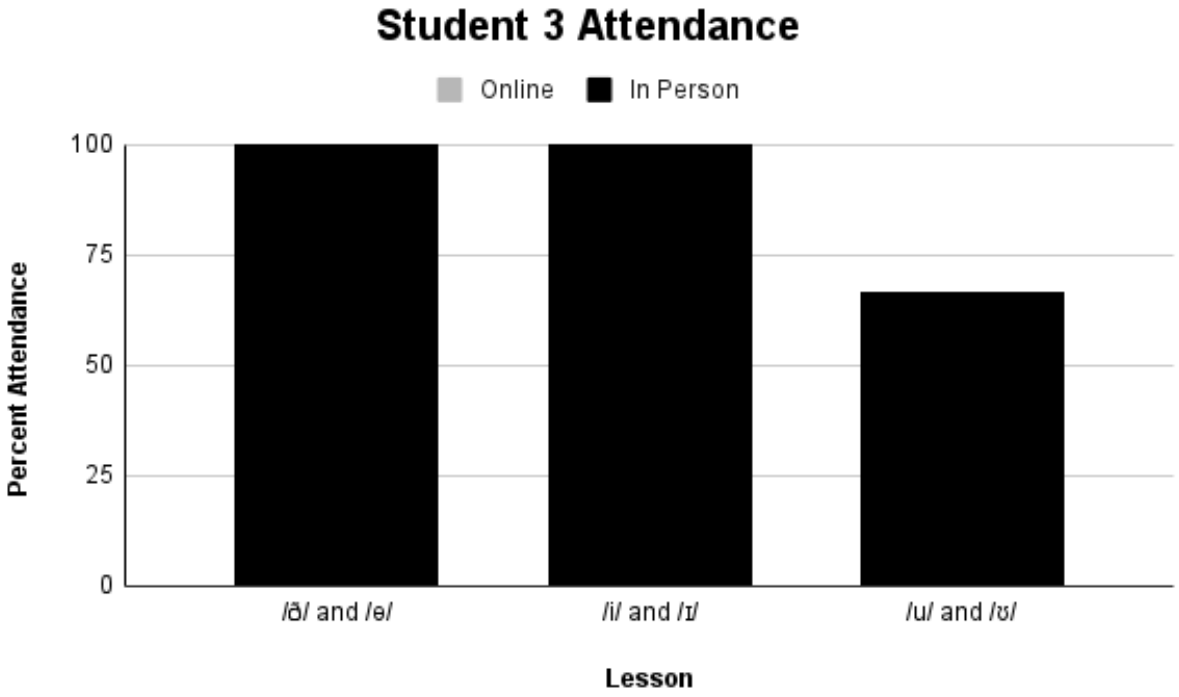


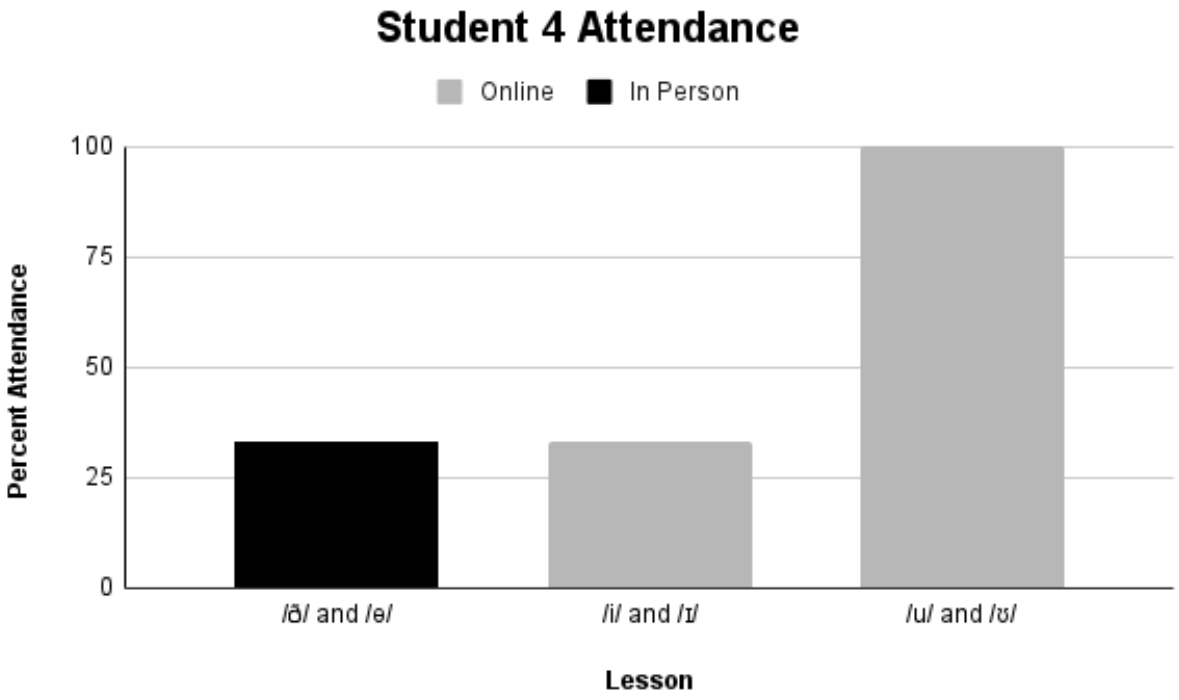
APPENDIX U

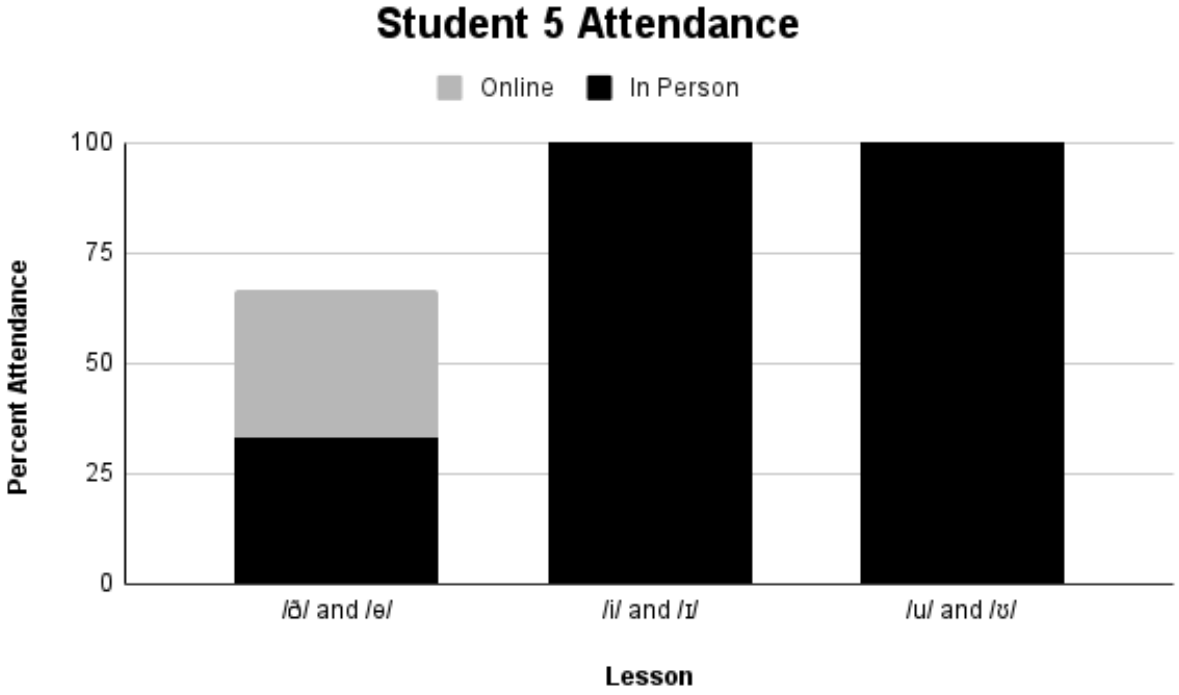
Student Attendance Graphs

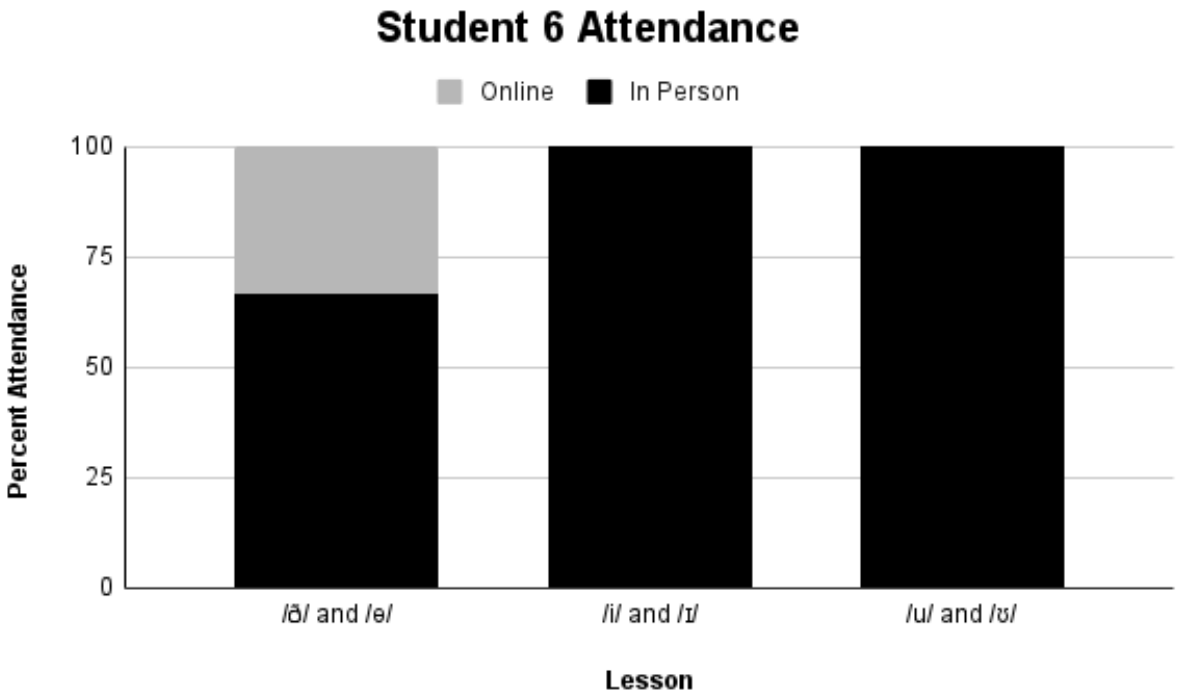


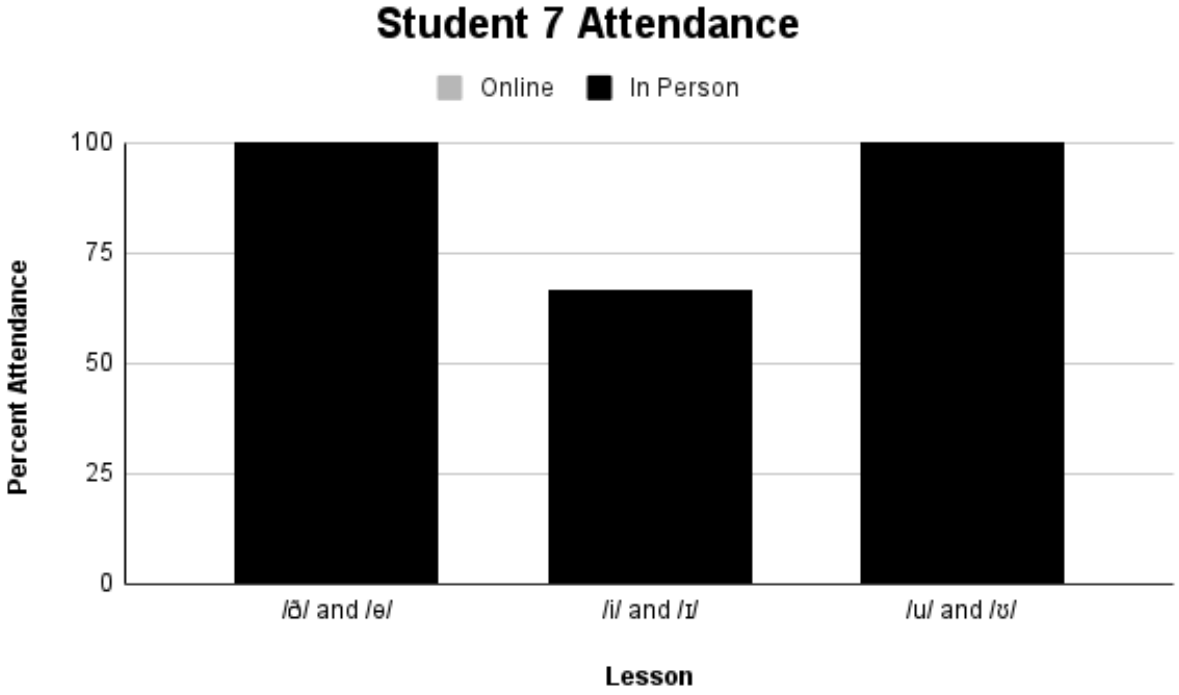


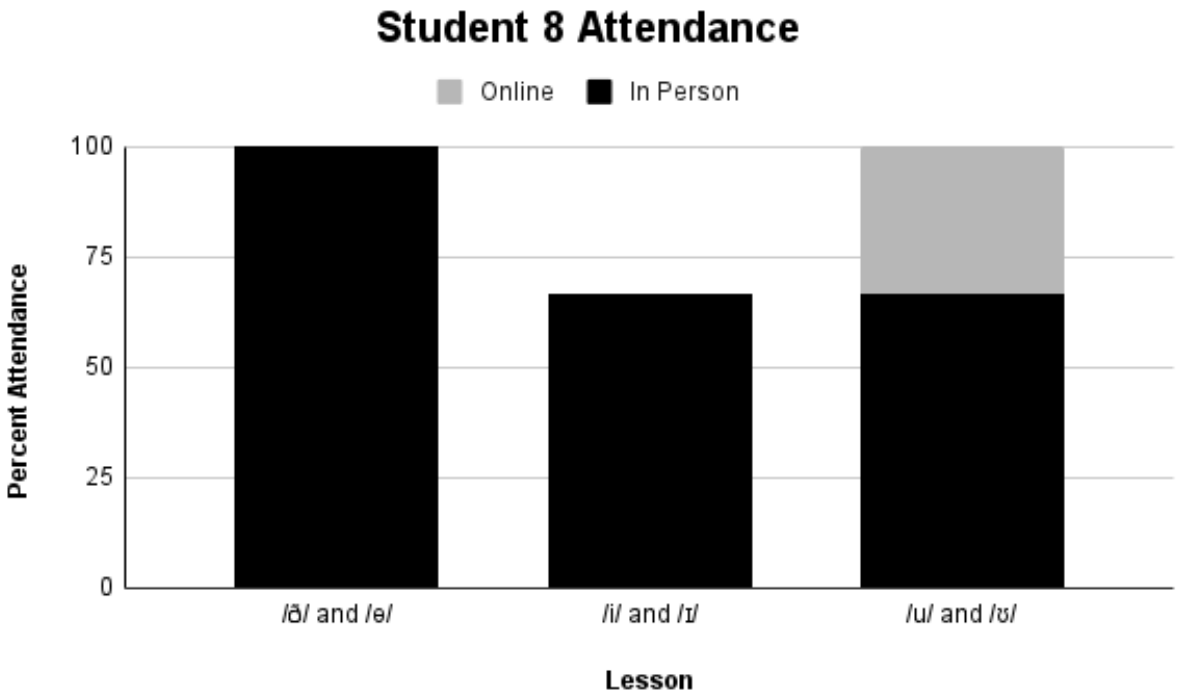

Student 3 Attendance
Online
In Person
100
75
50
25
0
Percent Attendance
/ð/ and /e/
/i/ and /ɪ/
/u/ and /ʊ/
Lesson

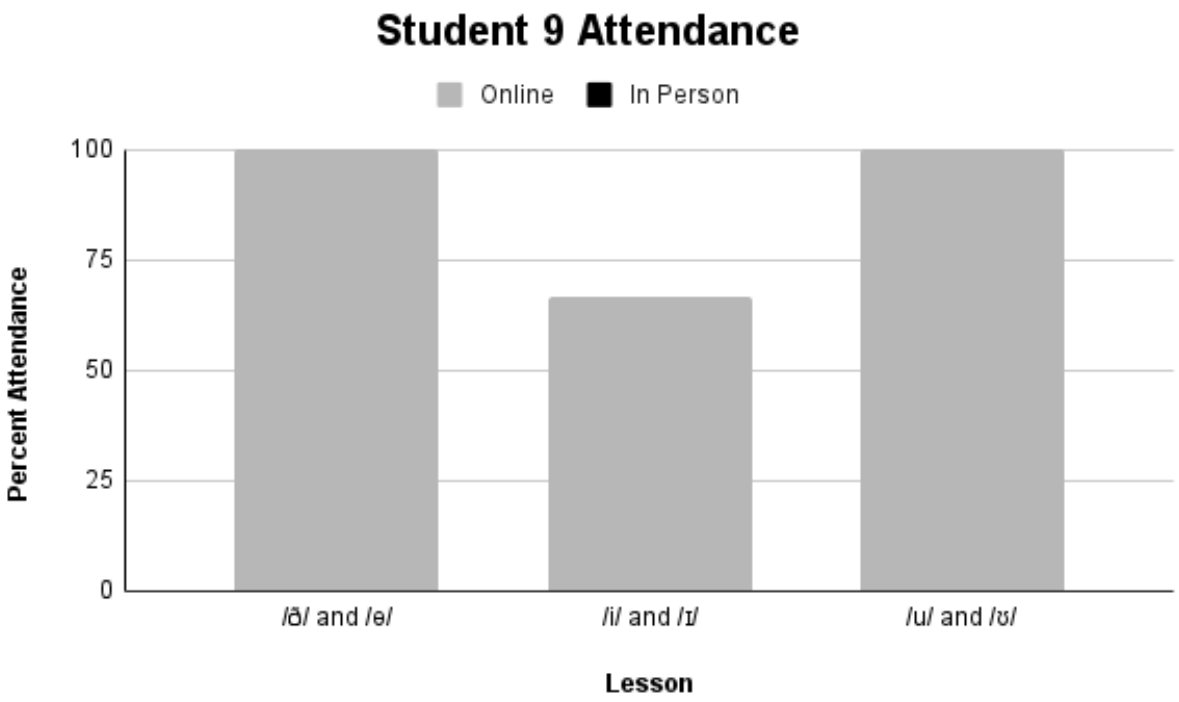

Student 4 Attendance
Online
In Person
100
75
50
25
0
Percent Attendance
/ð/ and /e/
/i/ and /ɪ/
/u/ and /ʊ/
Lesson


Student 5 Attendance
Online
In Person
100
75
50
25
0
Percent Attendance
/ð/ and /ɵ/
/i/ and /ɪ/
/u/ and /ʊ/
Lesson


Student 6 Attendance
Online
In Person
100
75
50
25
0
Percent Attendance
/ð/ and /ɵ/
/i/ and /ɪ/
/u/ and /ʊ/
Lesson


Student 7 Attendance
Online
In Person
100
75
50
25
0
Percent Attendance
/ð/ and /e/
/i/ and /ɪ/
/u/ and /ʊ/
Lesson


Student 8 Attendance
Online
In Person
100
75
50
25
0
Percent Attendance
/ð/ and /e/
/i/ and /ɪ/
/u/ and /ʊ/
Lesson


Student 9 Attendance
Online
In Person
100
75
50
25
0
Percent Attendance
/ð/ and /ɵ/
/i/ and /ɪ/
/u/ and /ʊ/
Lesson