ASL Search Part 2: Contributions IW Report

(aslsearch.onrender.com)
(https://github.com/anagha101/IW2)

1. Background

1.1 Introduction

ASLsearch is an online dictionary tool for American Sign Language, created in the Spring of 2022 for the Princeton Linguistics program. The web app remedies the issue of unreliable existing online ASL content, due to the immense variation in the background of ASL users, by providing a customized platform for Professor Buchholz's own content in a contextualized format. While ASLsearch in its current state is ready to use, it requires Professor Buccholz and his colleagues to manually upload all of the desired content, mostly signed videos they must upload to YouTube, to the platform themselves. This is a very arduous task that will be difficult to complete with just a few contributors, and could lead to the platform being underutilized.

The goal for this semester was to develop a contribution system for students to suggest vocabulary outside of the course curriculum, which would be moderated by professors. This will expand ASLsearch from a dictionary to more of a Wikipedia, in which students can both view ASL content as well as make their own additions. The content submitted by students must be approved by administrators in order to be posted to the site, not only lifting the burden of producing all of the ASL content for the platform from solely Professor Buchholz, but also allowing for greater student learning as students can research and submit their own content, receive feedback on their submissions, and ultimately grow as ASL users. I believe this additional feature and semester of work will bring the app to a point where it can be used by students and benefit the ASL program for years to come.

1.2 Motivation

Originally, ASLsearch was created to remedy the problem of variation in utilizing existing online ASL resources. As stated in the first semester's report, "Only 10% of Deaf people are Native users of ASL, meaning they were taught ASL formally as a first language. However, 90% of Deaf people are born to hearing families, and thus take many paths in finding their way to ASL, whether they first learn phrases through friends, online sources, caretakers, etc. Online dictionaries thus contain many variations of signs for a given English word, often without providing sufficient context for their usage, leaving students unsure as to which sign they should use." Creating the initial platform provided Professor Buchholz with his own customized online ASL resource to which he could feel confident referring his students.

However, the actual usage of the platform relies on first uploading translations for many English words. Specifically, professors would need to upload an English word, one or more definitions, and one or more signed videos per definition, repeating this process hundreds of times to cover the entire language. The task of uploading content can be broken down into two parts: course vocabulary for which Professor Buccholz has already created signed videos, and extra vocabulary which might be helpful for students. For the first set of vocabulary, Professor Buccholz and I have been looking into hiring an intern to upload his content to YouTube and then ASLsearch. The contributions system, or the heart of this semester's work, was intended for the second set of vocabulary, so that students could verify the videos they found online by suggesting them to the platform and, eventually, find these translations on the platform itself. Essentially, as more students contribute signs outside of the course content and ASLsearch grows, it will become a better resource for students to find the signs they are looking for in the

platform directly. Upon this semester's expansion, students can make their own contributions to the site, a learning process by itself, and thus have a hand in making the tool they will also benefit from as a resource. In turn, professors are unburdened from producing all of the platform content themselves and can simply approve suggestions, making the initial usage of the platform much less daunting and more accessible.

1.3 Related Work

When developing the initial platform, I compared it to existing online dictionaries and the features each provided/lacked. In the case of developing a contributions system, the most comparable existing resource is Wikipedia, "the free encyclopedia that anyone can edit."

To edit a Wikipedia article, users can click Edit next to sections of the text, and add edits in a "wiki markup view," or in a view of the actual page. Once pages are considered "complete" they get a check mark, and these verified pages are not able to be edited unless you are a Wikian, or have had a Wikipedia account for more than a certain number of days. This is also true for pages that are frequently "vandalized," as they call it, where users need a certain level of experience to make edits. For less popular pages, however, anyone can make a contribution, with or without a Wikipedia account, but Wikipedia still collects your IP address if you post anonymously. Users who post vandalism receive strikes and can be banned from contributing to the platform, which applies to your IP address so that users can't create a new account to continue posting spam.

Users are encouraged to add citations and post content in a formal, encyclopedia-like tone, via messages that appear throughout the upload process. There are categories for major and

minor contributions as well, such as editing wording vs. adding a new section, and the ability to make these contributions also corresponds to the amount of time a user has had a Wikipedia account. Adding an entirely new page requires approval from the site, which can take three to six months.

Wikipedia clearly has many protective measures against vandalism, from tracking IP addresses to restricting which users can edit which pages. However, ASLsearch does not need this level of protection for two reasons, the first being that students are CAS authenticated and their netid is provided along with their contribution to the professor. This will deter students from posting spam as it will eventually be seen by Professor Buchholz, which is the second protective measure of ASLsearch that is missing from Wikipedia: content is not uploaded instantly to the platform but awaits approval from administrators before it can be viewed by others. Since the platform is intended for only the Princeton ASL program, and only Professor Buchholz and his colleagues will be administrators, this narrows the scope of contributors and administrators from that of Wikipedia immensely. Content thus does not have to be uploaded instantly to the platform as there are much fewer submissions to moderate; instead, moderators can have total control over what gets published to the final product and can feel confident in the tools their students are using.

Another difference between Wikipedia and ASLsearch is that Wikipedia is mostly self-policed, which means that vandalism is reported by other users in the community. This would be the equivalent of a student noticing that an uploaded sign is incorrect and being able to modify it themselves. However, this scenario would never happen, again due to the moderation that happens beforehand in ASLsearch. Since professors have the final say in what gets

uploaded, and can edit student contributions before they are uploaded, everything that is eventually posted should be correct and in its final form. While students may notice that a certain variation of a sign is missing and be able to add definitions and signs to existing words, they will not be able to edit or delete existing content on the platform.

An important insight from studying Wikipedia was the segmented contribution process of creating new pages, sections, and actual writing. In the process of designing and iterating on the contribution system for ASLsearch, I debated creating a separate upload process contained entirely within the Contribute tab for students, even though uploading is broken down into word, definition, and sign for administrators. I wasn't sure how students could follow a similar segmented workflow if their contributions had to be submitted to administrators and thus displayed in their Manage Contributions tab. After looking at Wikipedia, I realized that users edited the pages in the same way; users could view existing pages and submit contributions on the pages themselves rather than from another hub. There only need for a Contribute tab at all would be for a student to manage their contributions or to upload a new page or word. After user-testing various options, this is the contribution I ended up implementing.

2. Approach

2.1 Gathering Requirements

This semester's work relied heavily on the input of students and administrators in designing a contribution/moderation system that was useful and intuitive. I began by creating Figma prototypes for a My Contributions page (later named the Contribute page) for students and an Active Student Contributions page (later named the Manage Contributions or just

Contributions page) for professors. As stated in Section 1.3 Related Work, I was not sure how to

implement student contributions at first, mainly wondering if students should complete a singular

upload process from the Contribute page or a segmented upload process similar to the existing

process for professors: first contributing an English word which creates a page where students

can then contribute one ore more definitions and signs. I began this semester of work on

ASLsearch by prototyping three versions of the contribution system using Figma and user-tested

these on both students and admins to determine what best served users.

2.1.1 Contribution System Version 1

The first version featured a Contribute page for students that listed the English word of

their contributions with dropdowns to view the definitions and signs contributed under that word.

Students would be able to edit, add, and delete content directly on this page using the dropdowns

and send it to admins, who could view the list with students' netids on their Contributions page,

edit the fields, and approve/decline the contributions. A red exclamation mark would indicate

that feedback has been provided on the contribution, which can also be viewed on the same page.
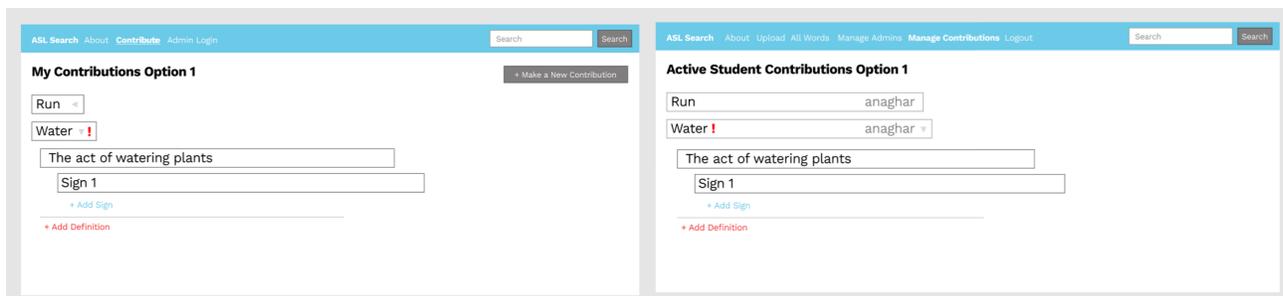
The problem with Version 1 is that there is a lot going on in one place. Unlike the

existing upload process via word pages seen in the first iteration of ASLsearch, the one-to-many

hierarchy of words to definitions to signs may not be clear in this view. It is also unclear how

feedback would be shown on each submission individually since the fields are all able to be

edited directly from the same page. Perhaps it could be nested at the same level as the definition, but this presents the same problem of a cluttered user experience.

2.1.2 Contribution System Version 2

In Version 2, students and professors would just see the list of words in the Contributions and Manage Contributions tabs. If a student makes a new contribution, they will see a form where they can add a word, definition, and content for the sign. They can then send it to the professor by clicking "Send." Similarly, professors can click on a word in the list of student submissions to open the form and view its fields. From here, they can edit the fields directly and click Approve to post it on the platform for everyone to see. If they want the student to change something, they can click "Add Feedback," opening a new field for feedback, and send it back.
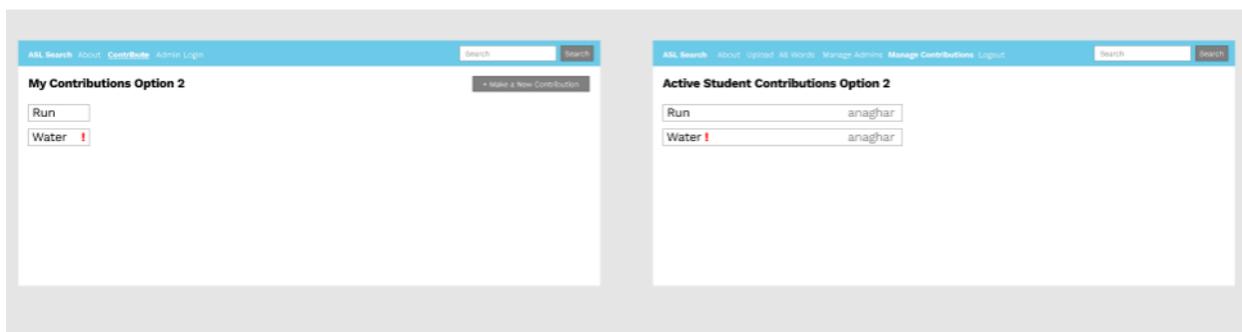
Version 2 is a bit better at separating the steps of managing contributions and editing the fields of the word, definition, and sign. However, issues still remain with the upload process:

1. How can students add a word with multiple definitions or signs? Professors have an interface first for adding the English word, then they can add a definition or sign from that page. How can students do all of this in one dynamic form?

2. What happens when students want to add content for a word that already exists in the dictionary? For example, if they want to add another definition or another regional variant of a sign, how can they do that from the contributions tab?

2.1.3 Contribution System Version 3
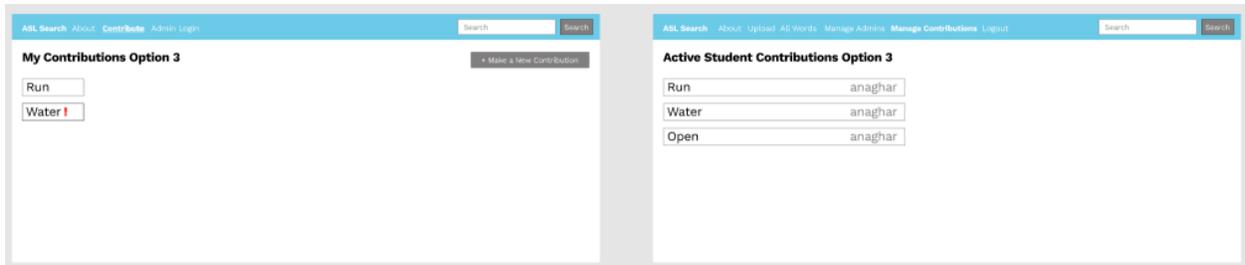
In Version 3, the prototype most similar to the final implementation, contributions are listed in a similar format, displaying just the English word of the contribution on the student end and including the contributing student's netid on the administrator end.

Clicking "+ Make a New Contribution" creates a pop-up or new page from where students can submit an English word to begin contributing to. If the word already exists in the dictionary, they will get a message with a link to the existing word's page, where they will see "Suggest a New Definition" and "Suggest a New Sign" buttons, similar to how admins already

see "Add Definition" and "Add Sign" to upload more content to an existing word.
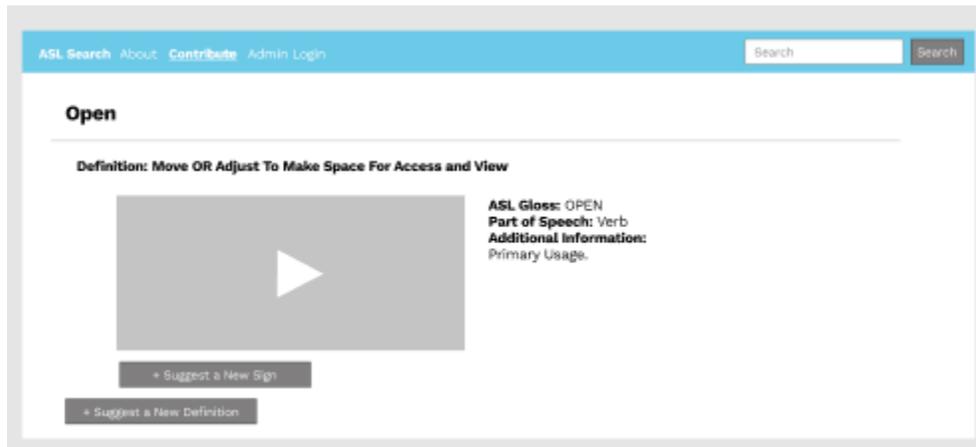
Otherwise, if the word does not exist, it will create a new contribution page where students can similarly suggest definitions and signs, just like the current workflow for professors. On the administrator end, professors can then click on a student contribution in the list to see this page, organized similarly to the word page for an approved and uploaded translation.

Newly contributed content would be displayed in a different color, so that it is clear what content existed already and what content the student is adding, especially in the case of contributions for an existing word. From there, the professor can edit the contribution, approve it, or add feedback and send it back to the student for revision.

Detailed notes from the user testing of these Figma prototypes can be found in Sections 7.2.1 and 7.2.2. Students and admins alike agreed that the third version of the contribution system was best for its consistency with the existing upload process and for creating a comprehensible breakdown/organization of content. Suggestions were made for the different actions that can be taken from the page: editing/deletion, sending feedback, and adding a permanent decline option, which were noted and used in the designing of an MVP.

2.2 Iteration

After understanding the users' needs through initial interviews, I began outlining the MVP and stretch goals for this expansion of ASLsearch. The MVP consisted of the main contribution system: management pages for students and admins, individual contribution pages, upload/edit/delete functionality, and sending/approving/declining functionality. I then conducted an additional round of user interviews in order to see how users actually interacted with the system. Notes can be found in Section 5.1, detailing the issues identified and features added from this round. I began fixing areas of confusion as well as tackling stretch goals, adding confirmation dialogs, email notifications, etc. Finally, I did a final evaluation of the app, asking students to upload real content and professors to moderate this content. Notes from this final round can be found in Section 5.2. In addition to fixing issues identified from these interviews, I tackled stretch goals related to the original existing platform such as video playback and hyperlinking. My approach to this semester's work was very heavy on user testing, as the underlying motivation was to ensure the platform will actually be used upon completion. User

testing allowed me to eliminate unnecessary features, identify and tackle new ones, and produce a platform that was intuitive and helpful for its users.

3. Feature Overview

To follow along, navigate to the app on any web browser at aslsearch.onrender.com. Please ensure autoplay is not blocked in your browser settings (especially on Firefox) for the best video playback experience. This feature overview will highlight changes from the previous system, rather than overviewing the entire platform's functionalities. To see an overview of features from the existing platform, see Section 3 of ASLsearch: IW Report from Spring 2022.

3.1 Login

3.1.1 User Types

The previous iteration of ASLsearch divided users into general users, admins, and superadmins. Only admins/superadmins could upload content, and superadmins were also able to give/remove admin privileges. Now, general users have been further divided into users and students. General users can simply search the dictionary, students can contribute content for admin approval, and admins/superadmins can approve/decline contributions as well as upload content themselves. General users do not have to log in, and will see this in the navigation bar:

3.1.2 Student Capabilities

Upon logging in, the system will check if the user's netid has been granted admin privileges. If not, after CAS authentication, the user will be given the user type of student. This

will change the navigation bar options and display a welcome message with the student's netid.

The navigation bar Login option changes to Logout, and the student sees an additional "Contribute" option, intended for students to make contributions.

3.1.3 Admin/Superadmin Capabilities

Upon logging in, if the user is designated an admin/superadmin in the database, after CAS authentication they will also see new navigation bar options and a welcome message with their netid.

For right now, Professor Buchholz and I are the only superadmins, and admin privileges are granted as needed, for example, to Professor Maier and Professor Dondero. In the navigation bar, the Login option changes to Logout, and the options Upload, All Words, and Users appear, all largely unchanged from the previous semester's work. "Contributions" is the only new tab, intended for managing student contributions.

3.2 Student Interface

3.1.1 Contributing to Existing Words

If the student searches for a word, like "Open," and navigates to its page, they will see a normal word page from the existing system, organized by definition then sign and containing contextual information on the side.

Definition: Of a person, frank and communicative nature
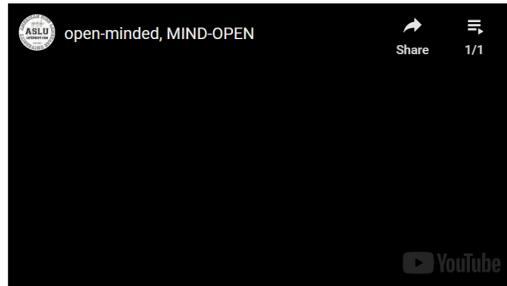
ASL Gloss: MIND-OPEN
Part of Speech: Adjective
Additional Information:
He/she/they is/are MIND-OPEN.

Contribute a New ASL Video

Contribute a New Definition

If the student scrolls through the bottom, they will see buttons for contributing new content, which are not visible to the general user.

Contribute Definition
Contribute a definition for "Open" then go to its page to contribute more definitions and ASL videos!

Definition*

Please find and copy a proper dictionary definition.

Contribute Definition

Contribute ASL Video

Contribute an ASL video and accompanying context for "Open: Of a person, frank and communicative nature", then go to its page to contribute more definitions and ASL videos!

ASL Gloss*

Part of Speech*

YouTube URL*

Additional Information

Optional. Include context for usage, regional variants, example sentences, or synonyms here.

Contribute Sign

Clicking on these buttons will take the student to Definition and Sign forms, which they can use to contribute content.

An existing contribution is already in progress for this word by another student. Try again later or contribute to another word.

Contribute Definition

Contribute a definition for "Open" then go to its page to contribute more definitions and ASL videos!

Definition*

(of a store, place of entertainment, etc.) officially admitting customers or visitors; available for business.

Contribute Definition

If another student has a pending contribution (not approved/permanently declined) for that word already, the student will receive an alert that they are unable to contribute at this time.

Open

Scroll down to contribute ASL videos for existing definitions, or contribute a new definition and corresponding signs!

Definition: Move or adjust to make space for access and view
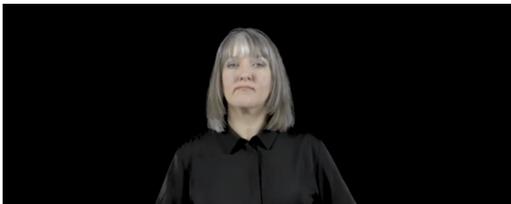
ASL Gloss: OPEN
Part of Speech: Verb
Additional Information:
Primary usage.

Contribute a New ASL Video

Definition: (of a store, place of entertainment, etc.) officially admitting customers or visitors; available for business.

✎ Edit   🗑 Delete

Contribute a New ASL Video

Contribute a New Definition

Finish and Send

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As long as there is not an active contribution from another student for this word, submitting the forms will create a contribution page, showing existing content in black and newly contributed content at the bottom in green. A note at the top of the page signals users to scroll down to the bottom to view their contributed content. The student cannot modify existing content, evident as there are no edit/delete buttons, but they can add definitions, signs, and links, and also edit and delete their contributed content.

My Contributions: mkhatri

Contribute a New Word

Pending
Drafts
Submitted for Approval
Open   🗑 Delete
Past
Approved
Declined

Once they are finished, the student can click "Finish and Send" at the bottom of the screen, which takes the student to their Contribute page and places the contribution under "Submitted for Approval."

3.1.2 Contributing a New Word

My Contributions: mkhatri   Contribute a New Word

Pending
Drafts
Submitted for Approval
Open   🗑 Delete
Past
Approved
Declined

From the Contribute page, students can also select "Contribute a New Word" to make a contribution, which will take them to a form.

Word already exists. View its page and scroll down to contribute new content.

Contribute Word
Contribute a new English word here, then go to its page to contribute definitions and ASL videos!

Word*

| dog |

Contribute Word

If the student unknowingly tries to contribute a word that already exists in the dictionary, they will be prompted to navigate to that page to view and possibly contribute additional content.

An existing contribution is already in progress for this word by another student. Try again later or contribute another word.

Contribute Word
Contribute a new English word here, then go to its page to contribute definitions and ASL videos!

Word*

| open |

Contribute Word

If the student tries to contribute to a word that another student has a pending contribution for, they will be asked to try again later.

You have already created a contribution for this word. View its page to edit or add content.

Contribute Word

Contribute a new English word here, then go to its page to contribute definitions and ASL videos!

Word*

open

Contribute Word

If a student tries to contribute a word they are already contributing to, they will be prompted to go to its page.

Art

✎ Edit

Scroll down to contribute ASL videos for existing definitions, or contribute a new definition and corresponding signs!

Contribute a New Definition

Finish and Send

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Except for these cases, contributing a new word will successfully create a new contribution page. Since the word is new, it will appear in green. The student can then go ahead adding definitions, signs, and links, and also edit and delete their contributed content.

My Contributions: mkhatri

Contribute a New Word

Pending
Drafts
Art   🗑 Delete
Submitted for Approval
Past
Approved
Declined

At any time, the student can exit the contribution and find it again in the Drafts section of their Contribute page. When they are done, they can Finish and Send their contribution, moving it to the Submitted for Approval section.

3.2.3 Possible Actions and Responses

As shown in Sections 3.2.1 and 3.2.2, a student's contribution can be found in Drafts until they send it to the professor, placing it in Submitted for Approval under the Pending section.

My Contributions: mkhatri
Contribute a New Word

Pending
Drafts
Submitted for Approval

Past
Approved
Open
Declined

If the professor approves their contribution, it will move to the Approved section.

Open

Definition: Move or adjust to make space for access and view

ASL Gloss: OPEN
Part of Speech: Verb
Additional Information:
Primary usage.

Clicking on the word will take the student to the approved word page, indicated by all-black text and no edit/delete buttons. There are only contribute buttons at the bottom of the page to contribute to an existing word, explained in Section 3.2.1.

My Contributions: mkhatri

Contribute a New Word

Pending

Drafts

Open `View Feedback` 🗑 Delete

Submitted for Approval

Past

Approved

Declined

If the professor would like the student to change something about the contribution before approving it, they can send it back to the student with feedback. This will move it from the Submitted for Approval section back to the Drafts section, with a badge that says "View Feedback."

Open

Scroll down to contribute ASL videos for existing definitions, or contribute a new definition and corresponding signs!

Instructor Note: Please find a short video that shows the sign once, rather than a long video explaining the sign.

Definition: Move or adjust to make space for access and view

ASL Gloss: OPEN
Part of Speech: Verb
Additional Information:
Primary usage.

If the student clicks on the word, they will see the contribution page they submitted with the professor's feedback at the top. They are able to edit/delete/add content and resend the contribution to the professor at any time.

My Contributions: mkhatri

Contribute a New Word

Pending

Drafts

Submitted for Approval

Past

Approved

Declined

Open `View Feedback` 🗑 Delete

Finally, the professor may decline the contribution permanently, still providing feedback. This would most likely occur if the student contributes something that already exists or is unnecessary for the platform.

Open

Scroll down to contribute ASL videos for existing definitions, or contribute a new definition and corresponding signs!

Instructor Note: I don't think we need this sign in the page for open.

Definition: Of a business, available and admitting customers

ASL Gloss: OPEN
Part of Speech: Adjective
Additional Information:
General sign for OPEN as a state or concept.

The student can click on the word to view their contribution and the feedback, but without any buttons for adding, editing, deleting, or sending content.

3.3 Administrator Interface

3.3.1 Viewing and Editing Contributions

Administrators can view contributed content from students by going to their Contributions tab.

Here admins can view a list of contributions, sorted into contributions waiting to be reviewed and contributions that have been sent to the student with feedback for revision. The other two categories, approved and permanently declined contributions, are not displayed.

Clicking on a contribution opens its contribution page, with student-contributed content displayed in green. Admins can edit/delete the student's contribution directly, before approving or sending it back to the student with feedback.

3.3.2 Possible Actions

Decline for Revision
Provide feedback on how the contribution can be improved and resubmitted.

Feedback

[   ]

[Decline for Revision]

Declining a contribution for revision means the student will receive the note with the ability to resubmit. This could occur, for example, if the professor wants the student to find a better YouTube video and doesn't want to dedicate time to it himself. Declining the contribution for revision places it in the Feedback Provided section of the Contributions page, where admins can revisit the contribution while waiting for the student to resubmit it.

Permanent Decline
Provide feedback on why the contribution is being permanently declined.

Feedback

[   ]

[Decline Permanently]   .

Permanently declining a contribution means the student will receive the feedback, but will not be able to edit or resend it to the professor. It will disappear from the admin Contributions page entirely, as requested in user interviews, but can be viewed by the student in order for them to learn from the feedback.

Learn
[✎ Edit]

Definition: To gain knowledge   [✎ Edit]   [🗑 Delete]

ASL Gloss: TO-LEARN(++)
Part of Speech: Progressive verb or gerund
Additional Information:
Sign once for learn in the past or future tense, sign twice for learn in the present tense with a finite duration or as a gerund (verb operating as a noun).

[✎ Edit]   [🗑 Delete]

[+ Add Link To Another Word]

[Upload a New ASL Video]

[Upload a New Definition]

Approving a contribution redirects admins to the newly created word page, indicated by black text and upload buttons replacing the approve/decline buttons. Approved contributions will also disappear from the admin Contributions page, since the word can now be found by searching the dictionary.

3.4 Stretch Goals/Added Features

3.4.1 Refining the New Contribution System

After creating the Contribution System, I sought to tackle stretch goals that would improve the user experience in order of priority. I started with email notifications, as this was highly requested during user evaluations. For email notifications, I used Twilio Sendgrid, integrating the service into my Flask application in order to easily send and receive emails. These notifications are only sent when actions are taken on a contribution, and users are first notified that an email will be sent before following through.
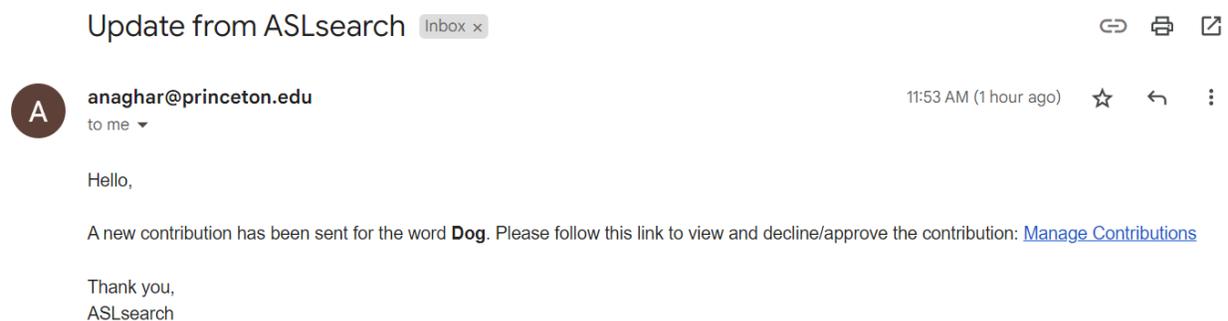
When a student sends a contribution to a professor, they will receive an email like so, specifying the word at hand, and providing a link to their Manage Contributions page.

Update from ASLsearch ➤ Inbox ×

A   anaghar@princeton.edu   11:54 AM (1 hour ago) ☆ ↰ ⋮
     to me ▾

Hello,

An update has been made to your contribution for the word **Dog**. Please follow this link to view its status and manage your contributions:
Contribute

Thank you,
ASLsearch

When a professor responds to the contribution, either approving or declining it (permanently or for revision), the contributing student will receive an email like so, specifying the word at hand, and providing a link to their Contribute page. Right now the default sender for all emails is my own student email, but I am looking to switch this to a service account, detailed in Section 6.1, so that users can feel secure in receiving official notifications from ASLsearch@princeton.edu.

As mentioned earlier, users are prompted to confirm they would like to go ahead with taking action on the contribution, informing them that an email will be sent if they confirm. These confirmation dialogs were my next improvement of the contribution system, and have been implemented for all major decisions in the platform. This ensures that emails are not sent by accident, cluttering users' inboxes, and prevents them from accidentally making permanent changes that can be inconvenient, like deleting a whole word page.
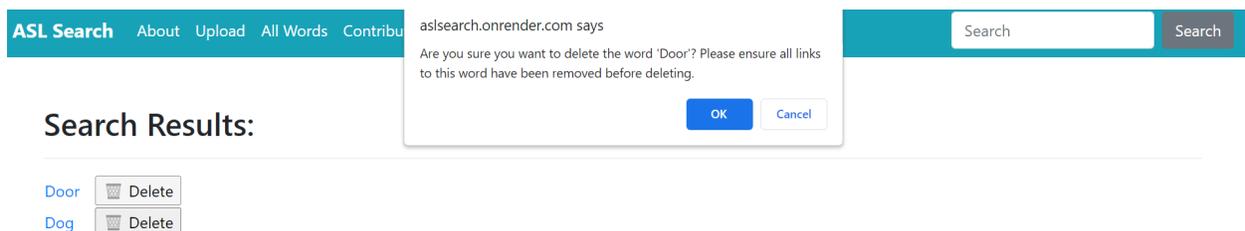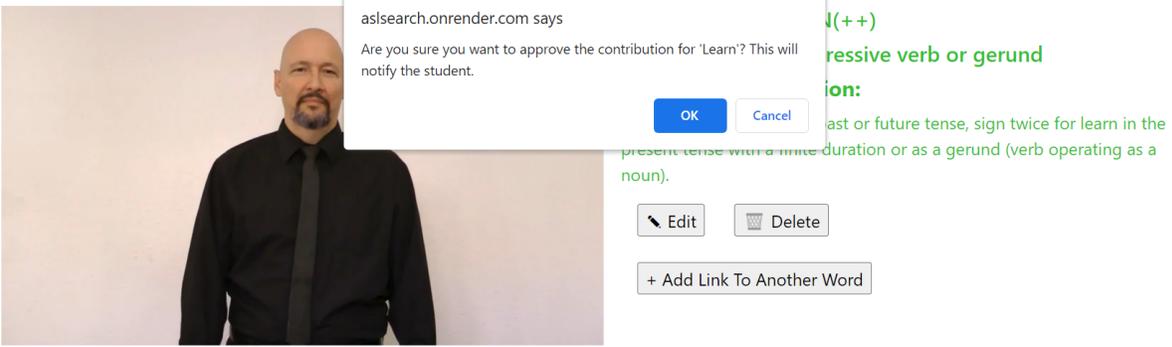
Essentially every button on the platform has a confirmation dialog from sending contributions back and forth, to deleting or adding content, to providing and revoking admin privileges. The only buttons I did not add confirmation dialogs for were edit buttons, as it felt tedious or overkill to confirm non-permanent changes. A user can re-edit if they make a mistake, but cannot un-delete a mistakenly deleted word. Confirmation dialogs definitely made the contribution system feel more secure and complete, as the user is now well informed of every action they are taking and its consequences.

3.4.2 Refining the Existing Platform

Hyperlinking was a suggestion I heard in user interviews from the first semester of ASLsearch until now. Many users who looked at pages for words like "Open," which contain signs like "OPEN-DOOR," stated that they would like to see a direct link to the page for "DOOR" from this sign. This semester, I was able to implement this through the Links table by creating a one-to-many relationship from Signs to Links.

ASL Gloss: OPEN-DOOR
Part of Speech: Noun-verb pairing
Additional Information:
Same as OPEN, but understood as OPEN-DOOR in context.

See Door.
Remove Link

Edit   Delete

+ Add Link To Another Word

Add Link
Add a link to a related word for the sign "TO-LEARN(++)", then return to its page to add more!

Word*

Add Link

A sign can have one or more related words called "links" that are displayed under Additional Information to the side of the signed video in the format "See ___." Clicking on the related word here will take the user to the page for that word, providing an easy direct connection between the two. Students and admins can add links to their uploads and contributions through the Add Link to Another Word and Remove Link buttons respectively.

Autoplay and looping to improve video playback was a requirement defined at the very beginning of the first semester of ASLsearch. Last semester, I struggled to make videos loop and autoplay by adding "&loop=1&autoplay=1" to the embed URL of the YouTube iframe, the suggested solution based on online research. After spending more time on video playback this semester, I uncovered that single videos not contained within a YouTube playlist needed to have the playlist parameter set to the YouTube video ID in order to make additional video playback

customizations like loop and autoplay work. So, instead of the URL https://www.youtube.com/

embed/uKKvNqA9N20?loop=1&autoplay=1, I needed to use a URL including playlist:

https://www.youtube.com/embed/uKKvNqA9N20?playlist=uKKvNqA9N20&

loop=1&autoplay=1&mute=1&controls=0. I added "&mute=1&controls=0" to mute the sound

of the video (though uploaded videos should not have sound, this was done as a precautionary

measure to be respectful of Deaf users of the site) and to disable controls cluttering the video.

The playback experience is now similar to a GIF that plays on repeat, without needing to press

play (though the user can still play/pause via clicking), with sound muted, and with no large

controls bar. I'm unable to show this experience in the report, but please follow along on your

own browser to see this feature.

Another added feature was the implementation of a search frequency metric by which

search results could be ordered. This was a stretch goal from the previous semester that I also

wasn't able to implement until now. I first created an Integer field in the Words table that

increments on each loading of the word's wordpage. Thus, as its page is visited more, the word's

search frequency metric would also increase.

Search Results:

Door   🗑 Delete
Dog   🗑 Delete

For example, after visiting the page for "Door" many times, it appears before "Dog" in

the search results for "Do," even though it does not come first alphabetically. Right now, it is

hard to see the effects of this feature as the dictionary is not very populated. However, over time

this will make a difference in suggesting more popular words to users first, rather than just

sorting search results alphabetically. This was one of the first strides in implementing better

searching, and will hopefully be followed by better word matching in searching, an

AJAX-powered dropdown, and other improvements in the future.

4. Implementation

4.1 Three-Tier Architecture
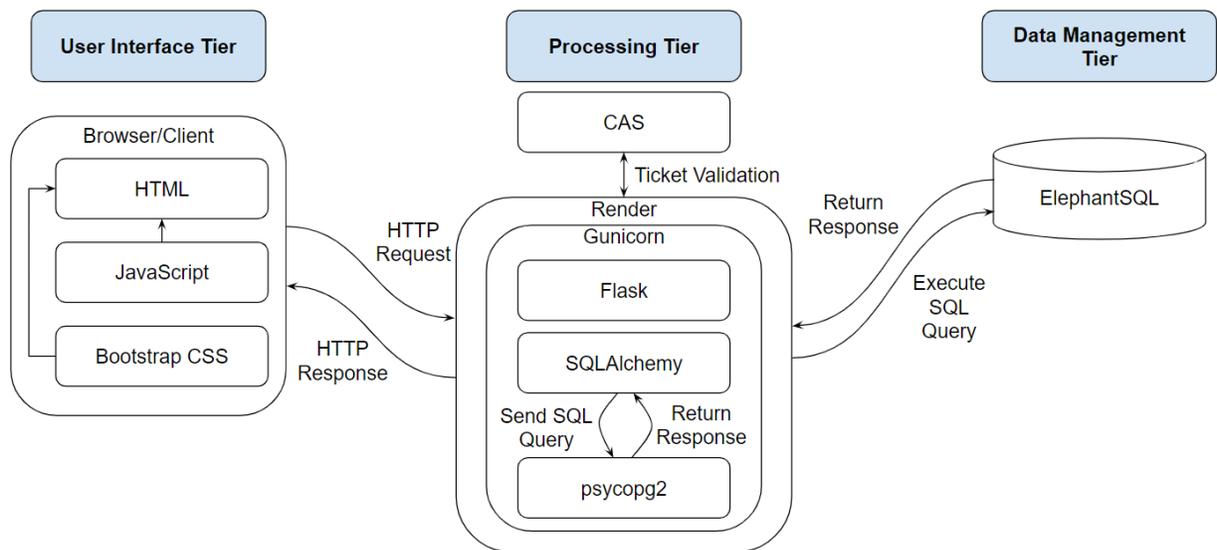
      The tools used throughout the platform have largely stayed the same from the previous

semester, but for replacing the web application hosting service Heroku with Render and the

database hosting service Heroku Postgres with ElephantSQL In the user interface tier, the user

interacts with the web application by accessing aslsearch.onrender.com through a web browser.

Navigating to different pages of the app sends HTTP requests to the Render web server: GET

requests for obtaining data from the processing tier and returning HTTP responses rendering

combinations of HTML, CSS, and/or Javascript, as well as POST requests for sending data to the

processing tier and updating the data management tier. Render is the cloud platform hosting the

web app in the processing tier, running a Gunicorn process as the WSGI HTTP server. Flask is

the server-side web framework the app is implemented in, with Central Authentication (CAS)

ticket validation used for administrator authentication. SQLAlchemy is the object-relational

mapper used to interact with the data management tier with Python code, facilitated by the

psycopg2 database driver. SQLAlchemy was used to create the database models/schema for the

ElephantSQL postgres database and to update the database.

4.2 User Interface and Processing Tier

New routes are described here with their functionalities. The remaining routes of the

application are not described here as they have not changed in their intended purpose, but many

of these existing routes have been modified, mostly for slight changes like restricting different

types of users from different routes.

- ➢ /**<string:word>/edit:** used to edit a word with the templates base.html and
  uploadword.html, prepopulating the Add Word form with the existing word and, on
  successful submission, changing the corresponding title field of the provided word in the
  Words table
- ➢ **<string:word>/<int:defid>/<int:signid>/addlink:** used to add a hyperlink from a sign
  to another word page with the templates base.html and addlink.html
- ➢ **<string:word>/<int:defid>/<int:signid>/<int:linkid>/removelink:** used to remove an
  existing hyperlink from a sign to another word page

- **/contributions:** used to view submitted student contributions in sorted categories with the templates base.html and contributions.html, only accessible by admins

- **/contribute:** used to view a student's own sorted contributions with the templates base.html and contribute.html, only accessible by students

- **/contribution/<int:contid>/<string:title>:** used to display the contribution page for the provided contribution with the templates base.html and contribution.html, displaying unapproved definitions and signs by querying the Words, Defs, and Signs tables; students can add, edit, and delete words, definitions, and signs from this route while admins can edit/delete content as well as approve/decline the contribution from this route

- **/contributeword:** used to contribute an English word with the templates base.html and contributeword.html, generating an upload form that adds a row to the Words database with the user input (of status unapproved) on successful submission and redirects to the newly created contribution page, only accesible by students

- **/<string:word>/editcontribution:** used to edit the provided English word contribution with the templates base.html and contributeword.html, prepopulating the Contribute Word form with the existing word and, on successful submission, changing the corresponding word_title field of the provided contribution in the Conts table

- **/<string:word>/<int:contid>/deletecontribution:** used to delete the provided English word contribution, i.e. removes the corresponding rows in the Conts table and, if unapproved, the Words table as well as all of its associated definitions in the Defs table and all of its definitions' associated signs in the Signs table, only accessible by students

➢ **/<string:word>/contributedef**: used to contribute an English definition with the templates base.html and contributedef.html, generating an upload form that adds a row to the Defs database with the user input (of status unapproved) on successful submission, relates it to its parent word, and creates a contribution if one does not exist already, only accessible by students

➢ **/<string:word>/<int:defid>/editcontribution:** used to edit the provided English definition contribution with the templates base.html and contributedef.html, prepopulating the Contribute Definition form with the existing definition and, on successful submission, changing the corresponding definition field of the provided definition in the Defs table

➢ **/<string:word>/<int:defid>/deletecontribution:** used to delete the provided English definition contribution, i.e. removes the corresponding row in the Defs table as well as all of its associated ASL signs in the Signs table

➢ **/<string:word>/<int:defid>/contributesign:** used to contribute an ASL sign with the templates base.html and uploadsign.html, generating an upload form that adds a row to the Signs database with the user input on successful submission, relates it to the provided word and definition, and creates a contribution if one does not exist already, only accessible by students

➢ **/<string:word>/<int:defid>/<int:signid>/editcontribution:** used to edit the provided ASL sign contribution with the templates base.html and uploadsign.html, prepopulating the Contribute Sign form with the existing inputs and, on successful submission, changing the corresponding fields of the provided sign in the Signs table

➢ **/<string:word>/<int:defid>/<int:signid>/deletecontribution:** used to delete the provided ASL sign contribution, i.e. removes the corresponding row in the Signs table as well as all of its associated linked words in the Links table

➢ **/<string:word>/send:** used to "send" a contribution from a student to a professor, updates the status of the corresponding contribution from 'PENDINGSUBMIT' to 'PENDINGAPPROVE,' moving its category in the student's Contribute page and displaying it on the admin Contributions page, only accessible by students

➢ **/<string:word>/approve:** used to "approve" a contribution submitted by a student, updates the status of the corresponding contribution from 'PENDINGAPPROVE' to APPROVED,' redirecting the user to the newly created word page, moving the contribution's category in the student's Contribute page, and removing it from the admin Contributions page, only accessible by admins

➢ **/<string:word>/decline:** used to "decline" a contribution submitted by a student for revision with base.html and decline.html, generating an upload form for admin feedback to be "sent back" to the student upon successful submission, resets the status of the corresponding contribution from 'PENDINGAPPROVE' to PENDINGSUBMIT,' moving the contribution's category in the student's Contribute page and in the admin's Contributions page, only accessible by admins

➢ **/<string:word>/permanentdecline:** used to permanently "decline" a contribution submitted by a student with base.html and decline.html, generating an upload form for admin feedback to be "sent back" to the student upon successful submission, resets the status of the corresponding contribution from 'PENDINGAPPROVE' to DECLINED,'

moving the contribution's category in the student's Contribute page and removing it from

the admin's Contributions page, only accessible by admins

➢ **<string:word>/<int:defid>/<int:signid>/addlinkcontribution:** used to contribute a

hyperlink from a contributed sign to another word page with the templates base.html and

addlink.html

➢ **<string:word>/<int:defid>/<int:signid>/<int:linkid>/removelinkcontribution:** used

to remove an existing contributed hyperlink from a contributed sign to another word page

4.3 Data Management Tier - SQLAlchemy and PostgreSQL Schema

The ASL Search database relies on SQLAlchemy schema which implements the

postgreSQL database in the data management tier. This is the conceptual schema of the database

in SQLAlchemy, though it actually creates an underlying postgreSQL database.
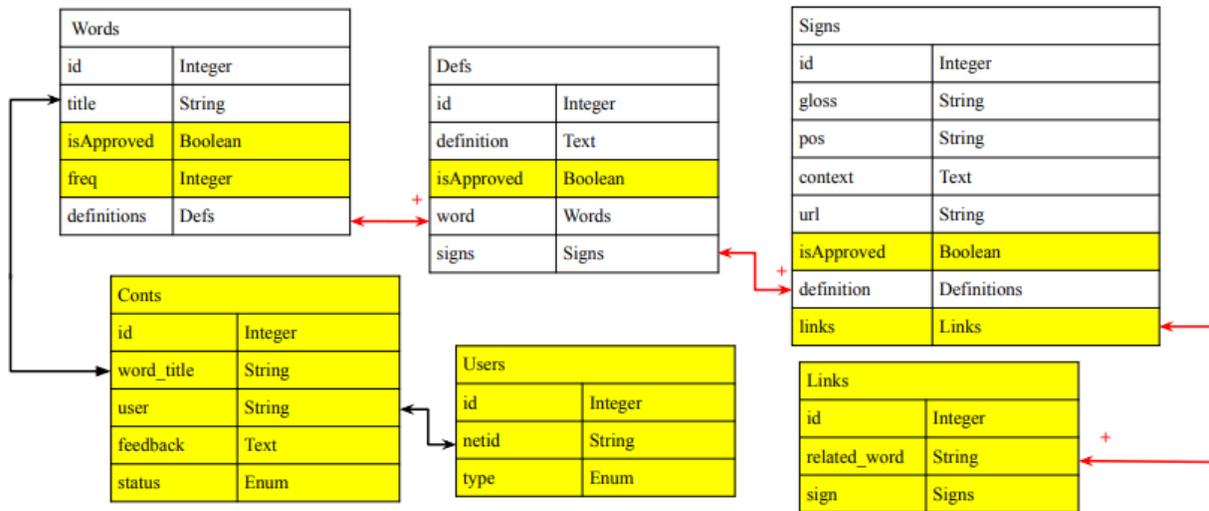
4.3.1 Changes to Words, Defs, Signs

➤ **isApproved (Boolean):** a boolean flag indicating if the word, definition, or sign is "approved" (true) and officially uploaded to the platform or "unapproved" and still part of a pending or declined contribution (false)

➤ **freq (Integer):** a field of Words, a metric that increments each time a word's page is navigated to, tracks the "popularity" of the word, used to sort search results

➤ **links (relationship field** — one-to-many relationship with Links implemented by a SQLAlchemy relational table): a field of Signs, all the "Links" or related words to a given ASL sign, displayed below the sign as a direct link users can take to its wordpage

4.3.2 Conts

➤ **id (integer):** unique numerical id for every contribution (primary key)

➤ **word_title (String):** English word the student is contributing or contributing to, helps connect the contribution to the word, defs, and signs contributed under it

➤ **user (String):** the Princeton netid of a given user, helps connect the contribution to the user contribution to prevent things like multiple simultaneous contributions

➤ **feedback (Text):** comments provided by an admin (professor) concerning a student's contribution, optional field that is only added when a contribution is declined (either to be sent back or permanently)

➤ **status (Enum ContributionStatus)**: current status of a contribution, can be 'PENDINGSUBMIT', 'PENDINGAPPROVE', 'SENTBACK', 'APPROVED', or 'DECLINED', corresponding to the categorization of the contribution in the management page for students and admins

4.3.3 Users

➤ **id (integer):** unique numerical id for every user (primary key)

➤ **netid (String):** the Princeton netid of a given user

➢ **Type (Enum UserType)**: category of the user, can be 'STUDENT', 'ADMIN', or 'SUPERADMIN', dictating the pages the users see and the options the user has

4.3.4 Links

➢ **id (Integer):** unique numerical id for every link (primary key)

➢ **related_word (String):** a related word to a sign, directly linked in the contextual information for the sign, allowing users to easily navigate to the page for the related word

➢ **sign** (**relationship field** — back-populate relationship with Signs, each link maps to exactly one sign): the ASL sign associated with a given linked word

4.3.5 PostgreSQL Schema

Words

id	INT (primary key)
title	VARCHAR(255)
isApproved	BOOLEAN
freq	INT

Defs

id	INT (primary key)
definition	TEXT
isApproved	BOOLEAN

Signs

id	INT (primary key)[1]
gloss	VARCHAR(255)
pos	VARCHAR(255)
context	TEXT
url	VARCHAR(255)
isApproved	BOOLEAN

Users

id	INT (primary key)
netid	VARCHAR(255)
type	ENUM('STUDENT', 'ADMIN', 'SUPERADMIN')

Words_to_Defs

word_id	INT (primary key)
def_id	INT (primary key)

Defs_to_Signs

def_id	INT (primary key)
sign_id	INT (primary key)

Signs_to_Links

sign_id	INT (primary key)
link_id	INT (primary key)

Links

id	INT (primary key)[1]
related_word	VARCHAR(255)

Conts

id	INT (primary key)[1]
word_title	VARCHAR(255)
user	VARCHAR(255)
feedback	TEXT
status	ENUM('PENDINGSUBMIT', 'PENDINGAPPROVE', 'SENTBACK', 'APPROVED', 'DECLINED')

This is the underlying postgreSQL database implemented with SQLAlchemy. The one-to-many relationships between Words and Defs, Defs and Signs, and Signs and Links are implemented by intermediate tables mapping primary keys to foreign keys, allowing words to have multiple definitions, definitions to have multiple signs, and signs to have multiple links.

4.4 Interesting Design/Implementation Problems

4.4.1 Contribution System

The main design problem of this semester's work was determining how to approach the contribution system: all at once or segmented. Details about this decision making can be found throughout the report, especially in Section 5.1.

4.4.2 Video URL Validation and Processing

Another interesting problem had to do with the handling of YouTube URLs. In order to display videos in the most lightweight fashion, I decided to use YouTube iframes rather than storing video files in the database. This requires the user to paste a YouTube URL in the input field while uploading a sign to the platform. The YouYube URL is validated to be a working URL, commonly copied from the browser search bar or the share link on YouTube, by checking it against a regular expression. This expression had to be robust to capture every possible variation of YouTube URL, which I was able to validate with the help of Stack Overflow. In the previous semester's implementation, I would then splice the last 11 digits of the URL, commonly the video ID, and use it to create a URL in the proper format for the iframe. For example, from

the URL https://www.youtube.com/watch?v=uKKvNqA9N20, it would take the video ID

uKKvNqA9N20 and create the embed URL to be inserted into the iframe:

https://www.youtube.com/embed/uKKvNqA9N20.

However, I realized there was an issue with this process, as sometimes YouYube URLs

could have a start time, channel name, or other variables after the video ID. Rather than taking

the last 11 digits of the URL, I needed to extract the video ID using regular expression groups.

So, for the URL https://youtu.be/uKKvNqA9N20?t=50, rather than taking the last 11 digits

incorrectly, qA9N20?t=50, I would now be able to extract the correct video ID uKKvNqA9N20

by selecting group 6 of the regex '^((?:https?:)?\/\/)?((?:www|m)\.)?((?:youtube(-nocookie)?\.com

|youtu.be))(\/(?:\?)*(?:[\w\-]+\?v=|embed\/|v\/)?)([\w\-]+)(\S+)?$'. After extracting the ID, I

would need to add additional variables for video playback to make the video autoplay, loop, etc.,

resulting in the final processed URL of https://www.youtube.com/embed/uKKvNqA9N20?playli

st=uKKvNqA9N20&loop=1&autoplay=1&mute=1&controls=0. The meaning of the additional

parameters at the end of the URL can be explained by Section 3.4.2. This was an interesting

challenge that was important to determine ford the main functionality of the app: playing signed

videos.

4.5 Testing

4.5.1 Internal Testing:

➢ **Checking function/method failures:**

In the previous implementation of ASLsearch, the only encountered Exceptions occurred

when an admin tried to upload a word that existed in the database, triggering a SQLAlchemy

integrity error since the title field should be unique. This was caught and the user was shown a message asking them to visit the existing page. Now, ensuring an admin is uploading a new word is handed by validation in the WTForm, and the link to the existing page is shown in an alert box. This has been standardized across the platform, as students also have many restrictions with contributing new words now, such as being unable to contribute to the same word as another student at the same time.

Furthermore, this version of the platform now has three error pages displayed to users in different scenarios. If the user is attempting to access a page they should not have access to, such as a student trying to access the Manage Contributions page or an admin trying to access the Contribute page via a URL, they will be shown a 403 Forbidden page error. If a user tries to navigate back to the URL for a contribution that has been approved, they will be shown a 404 Page Not Found error, as the contributed word should only have an accessible word page after being approved. Finally, if there is any server error on the system side, the user will be shown a 500 Unexpected Server Error page. This is in case any additional errors are encountered (which has not happened in the last few rounds of user testing), so that the user is able to return to the Homepage easily. The type of the error is then printed to the console (local) and to the Render logs (remote).

➢ **Validation**:

All input fields except for Additional Information in the Sign forms require some input, which is ensured by the DataRequired() WTForms validator. Furthermore, the YouTube URL field when adding a new ASL sign validates against a regex expression that matches a variety of YouTube URL sharing links. While this has stayed the same since the previous semester, the

conversion of YouTube URLs to a usable format for the video player iframe (extracting the video) process has changed, detailed in section 4.4.2.

As stated in the previous paragraphs, ensuring the uploading of unique content is also done via form validation now, showing various alert messages. On the admin side, if the user tries to upload an existing word in the dictionary, they will be shown an alert with a link to view the page. On the student contribution side, if the student tries to contribute to a word that is already being contributed to by another student, they will receive an alert that another contribution is in progress and they should try again later. If the student tries to contribute to an existing word, they will receive an alert with a link to view the page and contribute from there. If the student tries to contribute a word they already have an active contribution for, they will be shown a link to navigate to their own contribution (in the case where the student forgets they have started the contribution already). In all other cases, they will be able to contribute a new word. Finally, in the Add Link form, if a student or admin tries to add a link to a nonexistent word in the dictionary, they will be asked to try again with an existing word. These scenarios are displayed in Section 3.1.2.

4.5.2 External testing: Designing code or data to test your code.

➢ **White box external testing:**

Boundary testing was done by trying to add inputs with emojis, non-English characters, etc. I added many different English words with different numbers of definitions and ASL signs, creating contributions at different levels, which can be seen in stress_db.py. I also tried uploading

short and long inputs for the definition, additional information (Signs), and feedback (Conts)

fields, which are of type TEXT and have longer limits compared to Strings.

⚠ Field cannot be longer than 120 characters.

Length is restricted to 120 characters for words (Words and Conts), ASL gloss (Signs),

part of speech (Signs), URLs (Signs), related words (Links), and users (Users and Conts) by

WTForm validation.

Coverage report: 71%

coverage.py v7.0.4, created at 2023-01-12 16:59 -0600

Module	statements	missing	excluded	coverage
app.py	4	0	0	100%
aslsearch__init__.py	15	0	0	100%
aslsearch\config.py	11	0	0	100%
aslsearch\mailer.py	20	4	0	80%
aslsearch\main__init__.py	0	0	0	100%
aslsearch\main\database.py	0	0	0	100%
aslsearch\main\routes.py	686	112	0	84%
aslsearch\models.py	62	3	0	95%
aslsearch\sample_db.py	94	94	0	0%
aslsearch\stress_db.py	59	59	0	0%
Total	**951**	**272**	**0**	**71%**

coverage.py v7.0.4, created at 2023-01-12 16:59 -0600

I also conducted coverage testing with the python coverage tool, and was able to hit 71%

of the application's code. Sample_db.py and stress_db.py were used to populate my local

PostgreSQL database and migrate it to ElephantSQL, and are not used in a normal run of the

application. The only lines not covered in models.py were for tables where objects are not

directly utilized, calling its __repr__(self) function, and are not of concern.

```
798            db.session.commit()
799            return redirect(url_for('main.contributions'))
800        except Exception as e:
801            print(type(e))
802            return render_template('unexpectederror.html')
803    return render_template('permanentdecline.html', form=form, userType=get_user_type())
804
805 @main.route("/<string:word>/<int:defid>/<int:signid>/<int:contid>/addlinkcontribution", methods = ['GET', 'POST'])
806 def addlinkcontribution(word, defid, signid, contid):
807    form = HyperlinkForm()
808    signobj = Signs.query.get(signid)
809
810    if form.validate_on_submit():
811        try:
812            if (Words.query.filter(Words.title.ilike(form.word.data.capitalize())).first() != None):
813                link = Links(related_word = form.word.data.capitalize())
814                db.session.add(link)
815                signobj.links.append(link)
816                db.session.commit()
817                return redirect(url_for('main.contribution', contid=contid, title=word))
818            else:
819                return render_template('addlink.html', word=word, sign=signobj.gloss, form=form, retryAlert = True, userType=get_user_type())
820        except Exception as e:
821            print(type(e))
822            return render_template('unexpectederror.html')
823    return render_template('addlink.html', word=word, sign=signobj.gloss, form=form, userType=get_user_type())
```

```
8  from_email = Email(DEFAULT_SENDER)
9  subject = "Update from ASLsearch"
10
11 def send_email(to_email, toStudent, word):
12     if (toStudent):
13         content = Content("text/html",
14             '<p>Hello,<br><br>An update has been made to your contribution for the word <strong>' + word +
15             '</strong>. Please follow this link to view its status and manage your contributions: '
16             '<a clicktracking="off" href="https://aslsearch.onrender.com/contribute">Contribute</a>'
17             '<br><br>Thank you,<br>ASLsearch</p>')
18     else:
19         content = Content("text/html",
20             '<p>Hello,<br><br>A new contribution has been sent for the word <strong>' + word +
21             '</strong>. Please follow this link to view and decline/approve the contribution: '
22             '<a clicktracking="off" href="https://aslsearch.onrender.com/contributions">Manage Contributions</a>'
23             '<br><br>Thank you,<br>ASLsearch</p>')
24
25     mail = Mail(from_email, to_email, subject, content)
26     sg = SendGridAPIClient(SENDGRID_API_KEY)
27     try:
28         response = sg.send(mail)
29         print(response.status_code, response.body, response.headers)
30     except HTTPError as e:
31         print(e.to_dict)
32     except Exception as e:
33         print(e.message)
```

Similarly, the only lines not covered in mailer.py and routes.py are not of concern, mostly including exception handling that should not be hit during a user test of the application. This was the final iteration of coverage testing, and unhit/unnecessary lines were removed in previous runs.

➢ **Black box external testing:**

I conducted use case testing by executing the cognitive walkthroughs I designed for both students and administrators myself, before conducting several rounds of interviews with others. The functionality I had implemented usually worked, with bugs being fixed along the way, but user testing especially exposed difficulties that those unfamiliar with the app experienced and allowed me to improve the clarity of these functionalities, further described in Section 5.

The use of SQLAlchemy prevents against SQL injection attacks, as no SQL code is directly written or executed by the program and SQLAlchemy handles the creation of prepared statements. The use of jinja2 templates to generate all of the HTML in the platform prevents against cross-site scripting attacks, as user input text is never directly passed as HTML to the browser. However, the lack of input validation on English words, in order to allow for the broadest range of inputs, also creates the issue of buggy URLs, as words are directly linked to their pages in the search results. This can be solved through URL encoding or removing the word as a parameter in the URL, and is addressed in Section 6.1.1.

Finally, I conducted stress testing by adding a large number of random words using the python random-word library, which can be found in the stress_db.py file. Since last semester, I've changed this file to upload contributions at different levels - creating new words as contributions as well as existing words with contributed defs and/or signs. This is done by selecting 0 or 1 randomly using random.randint() and making each word, definition, and sign approved or unapproved corresponding to the number, creating a contribution if one does not exist already. Then, using the user interface, I also tried adding the longest word in the English dictionary, pneumonoultramicroscopicsilicovolcanoconiosis, uppercase and lowercase inputs,

which should work since I make all inputs capitalized before adding them to the database, and multi-word inputs like "Thank You," "Open Minded," etc.

5. Evaluation

5.1 MVP Evaluation

After deciding to implement Version 3 based on user feedback, I continually revised aspects of this contribution system based on feedback from users. I initially developed the MVP based on the Figma prototype, then conducted interactive user testing with students and admins. Complete task lists and feedback notes from the user testing of the MVP can be found in Sections 7.2.3 and 7.2.4. The feedback I received from these interviews led to many small changes, from displaying the user's netid in a welcome message upon login, to adding asterisks for mandatory fields in upload forms, to consolidating the confusing terminology of "suggesting" and "contributing" to only use "contributing." Both students and admins asked for a segmented contribution page that showed past and pending contributions in different categories. Interviews also led me to add a permanent decline option in addition to declining a contribution for it to be revised and sent back.

5.2 Final Evaluation

Finally, after adding these revisions and many other stretch goal features such as email notifications, confirmation dialogs for permanent database changes, etc. I conducted a final round of user interviews. Complete task lists and feedback notes from the final user testing of the

platform can be found in Sections 7.2.5 and 7.2.6. The group user interview was a great opportunity to see how students interact with the platform in the real world, uploading many types of videos with many different devices (phone, tablet, laptop). The variety and quantity from a group interview helped point out difficulties with the YouTube URL processing, as some URLs were not able to be uploaded. It also brought about the Edit Word feature, which I did not think was necessary beforehand, and the creation of different restrictions (routing to 404, 403, 500 errors) for which pages admins and students can view. This round of testing also confirmed the changes I made since the previous round such as a sectioned contribute page (past vs. pending) were well received.

After the final rounds of testing, I tackled stretch goals requested by students and admins throughout the user testing process, including better video playback (autoplay/looping) and hyperlinking so students can have a direct link from a sign to another related page. These final changes were user tested with Professor Dondero to eliminate bugs, but should also be user tested by students and admins to ensure the design satisfies its intended users.

6. Conclusions

6.1 Future Work

ASL Search remedies many problems with existing dictionaries and can be used right now by Professor Buchholz as it is. However, I plan to tackle additional improvements as needed this Spring and even over the summer, ahead of Fall 2023, when students may begin using the app. In the meantime, I hope to recruit one or more students to conduct a "LINternship" this Spring, working as a data entry intern for Professor Buchholz. The student(s) would be

responsible for splicing Professor Buchholz's vocabulary videos from the course, uploading them as separate videos for each sign to both YouTube and then ASLsearch. This would prepare the platform for use in the Fall, and data would need to be migrated if any changes are made to the codebase simultaneously.

I also considered creating a user's guide for the platform, but thought placeholders in different fields provided enough direction for now and chose to save this until closer to the Fall, in case of changes to the platform. Another problem to be addressed before the Fall is the issue of URL encoding, as uploaded words are used in the URLs of their pages, producing buggy outputs when special characters are uploaded. This can be avoided by storing the encoded and decoded versions of each word in the database in order to display the decoded version on the page and the encoded version in the URL, or by removing the word as a parameter in the URL entirely. A final future consideration is switching to a service account to send email notifications, rather than using my own. I have registered an account with OIT, but am unable to send and receive emails with SendGrid, even though the message header appears in the console log just as when I use my personal email. This seems to be an issue related to the service account that I hope to resolve with OIT upon returning to campus in the Spring semester.

6.1.1 Existing Weaknesses

The only glaring weakness in the functionality of ASL Search is its lack of advanced searching capabilities. As of right now, users must search exactly for the English word they are looking for or a matching substring of the word. This is problematic, as users cannot find the word they are looking for if they search for a keyword that is similar to the word but not a

substring. For example, if a user searches for "to open" or "opens," they will not find the word "Open" in the Search Results page. Fixing this would require modifying the database from Section 4.3 by adding an additional field in the Words table where Professor Buchholz can add a list of similar words to a given English word that can also be queried from the search bar.

Furthermore, I would like to display search results in a dropdown rather than navigating the user to a Search Results page and requiring an additional step. This would be implemented using AJAX to update the dropdown on each user keystroke as well as Javascript to render the dropdown both in the homepage and the navigation bar. An intermediate step to this goal would be displaying search results on the Homepage itself, below the search bar but not in a dropdown, which would eliminate the added step but would not look as clean or as similar to most online English dictionaries.

There are a few additional small weaknesses that I either did not have a chance to get to improving, or did not feel the work required was worth the incremental improvement. For example, when admins delete a word from the Search Results page, the page refreshes showing all of the words in the dictionary minus the deleted word. However, it would be clearer to show the same results (not all of the words), minus the deleted word, so the user can more clearly notice its absence from the list they had just been looking at. I found this feature to be low priority as word deletion should not happen often, and also wanted to wait until implementing a search dropdown, as both features require AJAX.

Furthermore, it has already been stated that when a student is contributing to a word that another student is already contributing to, they should be restricted. If the student attempts to contribute to this word from the Contribute Word form from the button on the Contribute page,

the alert will show up after the student enters and submits the word. However, if the word exists in the dictionary and the student attempts to contribute a definition or sign from its word page, they will be notified by an alert after filling out a much longer definition or sign form. I would like to show this alert sooner to prevent the student from putting in the work of filling out these longer inputs, perhaps immediately when the student presses the button. I did not implement this yet since the scenario is already so rare (2 students contributing to an existing word at the same time) and because the word page is already so cluttered, I wanted to avoid showing additional alerts on the page. These weaknesses are the only ones noted so far that have not been remedied, and will most likely be addressed before usage of the platform in the Fall. Finally, I would like to test different locations for buttons like finish and send, contribute, etc. since users could not always find them but a better location could not be determined from the user interviews thus far.

6.1.2 Stretch Goals

In addition to bettering searching, I also hope to add new features that were requested by Professor Buchholz or suggested through user evaluations.

One feature that I did not consider until user evaluations was the ability to control the ordering of definitions/signs on a word or contribution page. While interacting with the app, I would intuitively always upload the most common definitions/signs first, placing them first in the page as displayed to general users. This could be done by adding an integer field called "order" to the definitions and signs, which increments or decrements as users click on up arrow and down arrow buttons. The pages would then be ordered by this new "order" field.

Another feature I thought of while conducting the final round of user evaluations was a user management dashboard. After seeing the students make real contributions, I thought it would be nice for admins/professors to have a record of past student contributions, separate from the Manage Contributions page (which they specifically stated they did not want to see approved contributions on). This would fit in the User page, which currently is where superadmins can add and remove admin privileges for users. This page could also contain a list of users and their approved/declined/pending contributions. This could be helpful for professors to give class credit to students based on the number of successful contributions.

Finally, a suggestion that came from Professor Dondero was to provide more suggestions for user input. While discussing a tutorial document outlining the upload process and different standards for different fields (Ex: writing the word "Noun" in part of speech rather than "(n)" or "N"), he suggested using a dropdown instead. It would contain some of the more popular options ("Noun," "Verb," "Adjective," etc.), as well as an "Other" field with manual text entry. This could be done for several of the field inputs, for example, the Add Link form could have a dropdown with existing words in the dictionary for the user to choose from. Adding more suggestions for input fields using dropdowns would make the upload process easier for students and admins.

6.2 Acknowledgements

Overall, working on ASLsearch has taught me the importance of dedicating technological resources to ASL instruction and providing customizable platforms to give instructors the ability to make their own content and feel secure in the materials to which they refer their students. This

semester's work especially has been an interesting challenge and rewarding experience in designing interactive user interfaces. I would like to express my immense gratitude towards Professor Dondero, who met with me weekly during an already busy semester to advise me on this project, Professor Buchholz and Professor Maier for their consistent and invaluable input, and the students and peers who helped test and improve ASL Search over the semester.

7. Appendix

7.1 Figma Prototype Interview Notes

7.1.1 Student Interview Questions and Answers

For the initial Figma prototypes, I asked students questions about the upload process in a student contribution system rather than conducting an interactive walkthrough. I first described the app, then let the students look through the existing platform, then showed them the Figma designs, asking for feedback after each step.

Q1: Before seeing the platform or any designs, what are your thoughts about a student upload process?

- Imagine you'd drop in a link and it would upload itself
- Have a caption for the video with more information
- Similar to a google form with sections for all the required sections
- Example sentences

Q2: After seeing the admin upload process in the existing platform, what are your thoughts about a student upload process?

- This upload makes sense, would expect a similar multi-step process for students

- Might not be what students initially expect,

  - Students might expect upload to be entirely in what place

  - Takes a second to understand what things are sorted by English and ASL

  - If you're adding words you can figure it out though

  - A tutorial would be helpful for how to use the website overall

Q3: After seeing the Figma prototypes, what are your thoughts about a student upload process?

- Like the last option, most similar to the admin upload process

  - Don't need a video tutorial, but a document to remind people but be great

- Like that the page already exists alert directs back to the word

  - Otherwise would be confusing to have duplicate pages

- Might be useful to see the video at different angles, slowed down, change the speed

  - What's the hand shape, what's the sign

  - Mention handshape in the placeholder for upload

Q4: Do you have any additional suggestions for the student upload process, overall contribution system, or platform in general?

- Could be useful to have vocab categories after everything is uploaded

  - Corresponding with lessons in the ASL 1, 2, etc. sequence

- In case multiple students are trying to upload the same words, maybe suggested contributions can be "claimed" so someone else doesn't go do it

  - This probably wouldn't happen often

- Upload all of Noah's signed videos for the Princeton ASL vocabulary, then students can search for and suggest external videos for additional vocabulary

- LIN dept conducts internships sometimes, could get a "lintern" to help upload Professor Buchholz's content

- Some kind of permanent decline with feedback option in addition to sending feedback for revision

  ○ If the contribution is declined because the word already exists or something, the professor wouldn't want it sent back

7.1.2 Admin Interview Questions and Answers

Professor Buchholz and Professor Maier were already familiar with the existing platform ahead of designing Figma prototypes for the student contribution system. I showed them the designs and asked for their feedback on these initial designs, rather than conducting interactive walkthroughs.

Professor Buchholz Feedback:

- Thinks the contribution system in the third prototype will be awesome

- Concerned about students posting wrong information, so he likes that contributions have to go through their approval

  ○ Initially thought students would make their own signed videos but liked that they can suggest online videos they find - even easier

- He thinks that most dictionaries online are terrible - there is not one they fully trust

  ○ Either bc not enough terms, hard to search, or incorrect information

- ○ Also, there are specialized words/terms from class that they could include in this dictionary that they can't find in other online dictionaries (ex: in ASL 3 or 4, there may be different political terms like VOTE, DEMOCRAT, REPUBLICAN, PRESIDENT and the few online ASL dictionaries don't have all these terms)
    - ○ Also, words related to princeton itself (PRINCETON, EATING-CLUBS, TIGER, etc.)
- Would like to be able to edit the student's contribution to make upload faster
- Maybe in addition to approve/send feedback, admins could get edit and delete buttons on all the different parts of the contribution
    - ○ Sending feedback would mostly be in case he wants a different video for the sign and doesn't want to look for it himself
    - ○ He still would want the ability to edit the YouTube link directly as well as send it back to the student with feedback though
- Student would get the professor's edits if the contribution is sent back, they would see any changes made to the text box fields as well as an added message from the prof with feedback on the video/sign
- He would also like to be able to see who submitted the form - maybe students could be incentivized to add signs as part of their grade
    - ○ Maybe at the end of the semester he could ask students to try uploading some content

Professor Maier Feedback:

- Definitely prefers the third version

- He is most concerned about the wrong information showing up if students are able to contribute their own content

- Likes the approve/send feedback moderation system, would also like to be able to decline permanently

  ○ Still would send feedback, but the student can't send it back

- Likes the communication style where students can send things, professors can respond, etc.

- Asked if students can communicate with each other

  ○ Maybe could collaborate on a contribution, just a suggestion

- Would also like to see better searching, this is a big issue with existing online dictionaries

7.2 MVP Interview Notes

7.2.1 Student Task Lists and Feedback

For this round of student interviews, I conducted a group session with one of Professor Maier's ASL 1 classes, in which I walked about 20 students through the app and asked general questions. I then conducted three individual student interviews and one interview after class and one interview with Professor Dondero Acting as a student.

Group Interview Task/Question List:

- Homepage - search bar is the main component, there is also an about page

- Task 1: Login and search for "Open," click on the wordpage

- Explain - how the system works from last semester

- Question 1: How do you feel about this platform?

- Question 2: If it had a ton of words, would you use it as a resource for class?

- Question 3: What concerns/hesitations do you have about it?

- Question 4: I have one specific question for all of you - what would you want to see in the case of synonyms? (explain pet peeve/annoy example)

- Explain - overview of the student contribution system

- Question 5: What are your initial thoughts on this idea without seeing anything?

- Task 2: Make a contribution, fill out word/defs/signs,

- Question 6: What concerns/hesitations do you have about it?

- Question 7: Would a tutorial page with screenshots of the different features of the app mitigate some/all of your concerns?

Group Interview Feedback:

- Very useful, contextual information is really good

- Really like this idea, helpful for beginners, wants trustworthy ASL tools

- All thumbs up

- Concerns

  - There could be too many variations, but the context helps

  - The most common sign should be at the top

  - If words have similar signs, there could be an icon referencing the other word w the same sign -> hyperlinking

- Contributions

  - Likes the quality control to keep profanity and derogatory language off the platform

- ○ Concerns - might overburden the professors to look through the whole dictionary and approve all the requests, some incorrect things may leak through
  - ○ Tutorial would be good

Individual Interview Task/Question List:

- What do you think you need to do in order to see upload options?

  - ○ A: Login

- Task 1: Login

- What do you see? What do you think each of the tabs does?

- Task 2: Make a contribution with filler info

  - ○ Ask questions/observe difficulties with upload

- What do you think would/should happen if you tried to upload something that was already on the site, like "Open"?

- Task 3: Try to upload an existing word

  - ○ Do you expect to be able to contribute more content to an existing word as well as contribute an entirely new word? If the reroute takes you here, where do you expect to do that?

- Task 4: Add suggestion to existing word

- Do you think your contribution is now instantly accessible by the professor, or do you think you need to do some sort of confirmation first?

- Task 5: Click Send

- How would you now try to find your contribution? Would you expect it to come up in the search bar?

- Task 6: Access/edit contribution from "Contribute"

  - Do you expect to be able to edit once you send? Is it clear which contributions you have and haven't sent? How do you imagine this would be clear?

- What expected behaviors do you see the professors having/doing with the contributions?

  - A: approve/decline, feedback

  - (Send the student feedback now)

- How do you expect to be notified of feedback?

- Task 7: Refresh My Contributions and see red exclamation

- What do you think that means? What would you do?

- Task 8: Click on contribution and view feedback

- What abilities do you think you should have now?

  - A: delete, edit and send again

- Task 9: Edit and send again

- (How) do you expect to be notified if your contribution is approved? Where do you think you could find it?

- Task 10: Search for the word

- Overall do you have any concerns about the upload process? Is step-by-step confusing?

- Is it clear if/when content is actually sent to the professor or not?

- Do you want more guidelines?

- Issue of what to do after feedback - ability to edit and send again?

  - Send using a send button or automatic when you suggest any content?

  - See the status in the Contribute page? [EDITING, SENT, NEW FEEDBACK]

- - - ■ Ability to edit after being sent then?

- ● General thoughts?

Student 1 Feedback:

- ● To contribute, expects an option to suggest in the navbar

  - ○ A little confused that she had to login first

- ● After logging in, like the interface, clean and simple, assumes the two searches are the same

- ● Uploaded a test word easily!

- ● Expect trying to upload a word to tell you it exists and show you the page! Perfect

- ● Expects to be able to contribute more info to an existing word, maybe not the basic ones

  - ○ Expects to find this on some sub-function in contribute or on the results page have something more to add

- ● Thought the suggest buttons would be at the top, not the bottom, if there were a lot of videos people wouldn't know they could suggest

- ● Confused by location of buttons and what they mean

- ● (Showed her another person's contribution as an example)

- ● Wouldn't expect it to automatically show up on the page after adding the definition - looks like it's already uploaded even if it's not

- ● After hitting finish and send, expects it to be sent

- ● Notification after approval or rejection with a change

- ● Exclamation means you have to fix something

- ● Expects to do it by clicking on the word to see the feedback

- Expect to be able to edit and resend before it's approved until it's approved

Student 2 Feedback:

- Expects a Contribute button, either to upload their own videos of them signing or a link to goreact? - after explaining the platform uses YouTube videos, thought this made sense

- Also suggested a form beforehand that says I'd like to submit with a plan
    - Prevent people from going through the work for something that won't be approved, might be a lot of work though

- Suggested having login after clicking on contribute

- Tried to do an existing word - this already exists, could be helpful to see what's there already

- Would like a button to take you back to the contribute page? Didn't think to use the back button of the browser

- Expects to only make new contributions, then saw suggest buttons on the existing page

- The sign upload feels like a lot of fields - are they all mandatory?
    - Should probably add asterisks

- Likes the multiple videos and definitions, thinks it makes sense - but thought she could only add one definition at first
    - Really seeing the need for a tutorial

- Expects content shouldn't be directly posted site, expects some confirmation that the contribution has sent

- Professor should be able to approve, leave a comment /send feedback

- Refreshed to get the message, saw the exclamation, clicked on the word, saw the feedback, expects to edit and submit again! Perfect

- Notifications for feedback/approval - email

- Would find it more helpful to have a checkmark next to an old contribution that has been approved - past contributions section or something?

Student 3 Feedback:

- Logged in to get access to contributions

- Expects "Contribute" to be where you upload, about is a general overview

- Upload existing word - expects it to take you to the existing page and may give option to add new things

  - Not sure if that's necessary, unlikely that students can contribute more than is already there most of the time - suggest buttons makes sense though

- Different suggest ASL video buttons for different definitions makes sense

- Thinks the step by step upload seems logical

- Makes sense to have a moderator, expects a finish and send button, likes it there

- Imagines if you edit before professor views you just have to send it in again

- Professor actions - approve and upload, make edits themselves as well as send feedback back to the student

- Expects a notification on reload, feedback is clear

- Now she can edit and send it again

- After approval, expects another icon indicating it's been posted - thinks it's not bad for people to have a log of past contributions vs. pending contributions

- Would like email notifications as well

Professor Dondero Feedback:

- Initial navbar tabs make sense

- Assumes he needs to login to start uploading things

- Understands CAS but would be more comfortable if he saw a welcome message referencing rdondero - confirmation the system knows who he is

    - Login changing to Logout is a good indication but that would be better

- Contribute page - could be nice to put "none" under my contributions to indicate he hasn't made any yet

- "Suggest a Word" could be more clear - to whom? Maybe "Create a new word" or "Contribute a New Word"

- Wasn't clear that the sentences were definitions in the page for Open

    - Maybe it should say "Definition: " beforehand

- Suggest a new word - maybe put "please use a real definition" as a placeholder

- Makes sense that he would have to finish and send but couldn't find the button

- Expects to not be able to search for a contribution

- Expects to be able to edit the contribution by clicking on the word

- Expects the admin can approve, deny, or "conditional approve" (with feedback)

- Notification in the system and outside

    - In the system - pending vs. approved vs. denied contributions

    - Out of the system - email

- Exclamation point for feedback isn't clear - could add words

○ Ex: "Declined - click here for instructor feedback"

○ Would like to see multiple parts on this page

7.2.2 Admin Task Lists and Feedback

For this round of admin interviews, I conducted thorough walkthroughs with Professor Buchholz and Professor Maier, giving them a fixed task list and recording their feedback. I asked about old and new features, identifying areas of improvement from the old platform and seeing their thoughts on the new contribution system.

Admin Task/Question List:

- What do you think you need to do in order to see admin capabilities?

  ○ A: Login

- Task 1: Login

- What do you see? What do you think upload does?

- Task 2: Click on Upload but don't do anything

  ○ Do you think this is uploaded to the official site or a suggestion?

- What do you think All Words does?

- Task 3: Click on All Words but don't do anything

  ○ Is this useful? When there are many words what would make this useful? Is there a better way you would expect to delete words?

- Task 4: Click on a word in All Words

  ○ What do you see? Do the buttons make sense? Do you want a delete word option here? Do the add buttons make sense?

- What do you think Users does?

- Task 5: Click on Users, try adding an admin

  - Does this make sense? Can the tab be named better?

  - Does adding/removing admins make sense? Who should be a superuser?

- What do you think contributions does?

- Task 6: Click on contributions

  - Is this what you expect to see? Does the name make sense?

  - What do you expect to see when clicking on the contribution?

  - What options do you expect to have for reactions to the contribution?

    (Approve/decline)

  - Knowing "Open" already exists, what do you think of this contribution?

- Task 11: Click on "Open"

  - What do you see?

  - Is it clear this is a contribution?

  - Are you inclined to scroll down?

  - Does the position of approve/decline make sense? Better at the top?

  - What do you think the green means?

  - Do you think you can directly edit the fields?

- Task 8: Try changing the definition

  - Does that make sense?

- What do you think decline with feedback does?

- Task 9: Click on decline with feedback, don't confirm declne

  - Do you expect to see the contribution in your tab still?

- Task 10: Click Decline

  - Is the behavior what you expected?

  - Knowing "Door" does not exist, what do you expect to see?

- Task 11: Click "Door"

  - Thoughts?

  - What do you think approve and upload does?

- Task 12: Approve "Door"

  - Is this what you expected?

  - Where do you expect to find the contribution now?

- Task 13: Search for "door"

  - Does this make sense?

- Overall:

  - How do you expect to be notified of a new contribution?

  - Is any behavior unclear (for you or students)

  - General thoughts?

Professor Buchholz Feedback:

- Understand login, about, upload

- Okay with delete word option being in all words

- Thought users would be to see a list of all users

  - Thinks it's fine that you can't though, only need to see admins

  - "Users" title is fine, "Manage Users"

  - Future feature could be a student dashboard, see their contribution history

- Contributions - thinks it has ones that have not been approved or need approval

  - After clicking, understands there are two contributions by mkhatri

  - Clicking on the link should show the contribution for Door, and another contribution for Open

  - Expects to be able to edit the contribution, button for approve/upload, and comment box to send back to the student

- Clicking on Open

  - Scrolled down, saw the contribution

  - Initially looked at the whole page, wants a different color to indicate that it's a new section, even though this is indicated by the lack of Edit/Delete on the other parts

  - Likes that he can directly edit/delete

  - Approve/decline buttons are hard to find at first

- After declining with feedback, would still like to see the page

  - Maybe have a declined waiting for resubmit area?

  - Pending approval, decline/need revision, declined/deleted (don't want)

  - Wants to still see the declined/need revision - in order to go back and see, to edit the fields again, edit the feedback as well

- Approval made sense, wants notification by email

Professor Maier Feedback:

- Understands login, about

- Initially thought upload wouldn't fully post to the site, could have to go through approval

- - Knowing it's only available to admin, understood upload is adding to the website

- Wordpage - added the word creative

  - Not sure if definition refers to English or ASL

  - Would go look up a definition for the definition

- Contributions -Would like to be able to approve, decline, edit, and give feedback

- Didn't see approve/decline buttons at first

- Thinks that he should be able to see each student's netid somewhere

- Thought it was obvious to scroll down to see contributions - from the colors, from the lack of edit/delete

- Decline with feedback makes sense - if he wants to reject it entirely, then he would want to give feedback but also decline

  - Two buttons on this page maybe - send feedback for revision vs. reject entirely

  - This form needs an asterisk

- After declining, would like to still see the contribution in order to go back and view it, edit the feedback, etc.

  - Would like to see different statuses - new contributions, if he sent it back,

  - Would be nice to see the original contribution if they edit and send it back

  - Would not want to see all of the rejected ones

  - Would not want to see approved contributions either

- Notification from the status in the system, maybe also emails

  - Don't want individual emails for each one, maybe a summary each week but this could be overkill

7.3 Final Round Interview Notes

7.3.1 Student Task Lists and Feedback

For the final round of interviews, I conducted group and individual walkthroughs. I met with Professor Maier's class again and asked them to each upload a vocabulary word they would like to learn from outside the course curriculum. I asked them to try using various devices, from phones to tablets to laptops, and to mess around with editing/deleting fields before finally sending it to the professor. For the individual rounds, I gave a more specific task list that more thoroughly covered all of the features I had implemented. I also asked both individual interviewees to contribute to the same existing word to test if multiple contribution handling worked.

Group Task List:

1. Login

2. Contribute a new word

3. Add definitions and signs

    a. Edit/delete content

4. Send

Group Notes:

- Thumbs up all around

- One student submitted on mobile and it took two tries to submit - student may have just not hit the button the first time since we could not replicate the problem

- FAQ page - describe how you need youtube URLs

- Annoying that you can't edit the word if you're farther in the process

- ○ Requested an edit word button on the word/contribution page
- When copying the URL from the browser it didn't work for one student
- Had to click share and copy the link - go see why the URL isn't working
  - ○ Her URL has the channel at the end, so the video id is not the final 11 digits

Individual Task List:

1. Login
2. Search for an existing word "open"
3. Contribute to the existing word and send
4. Contribute a new word "squash"
   a. Edit/Delete fields and send
5. Refresh to view feedback
6. Edit and resend

Student 1 Notes:

- Thought it was clear to contribute to an existing word - can't edit existing content, only add new content
- The URL also didn't work for this student - video unable to play
  - ○ This seems to be because of the video permissions - used a random disney video that may be copyrighted
- Thought the view feedback banner was much more clear and liked the sectioned contribute page
- Easily edited and resent the contribution

Student 2 Notes:

- Wasn't allowed to contribute to the existing word since another student's contribution was in progress
    - Thought this was clear, doesn't think this situation will happen often so blocking it is a fine solution
    - Tried to contribute from the word page itself and it let her - need to add the blocking to the existing contribute buttons, not just for contribute a word
    - Thinks it's good that you can't see another student's contribution - a student should not see anything on the platform that isn't moderated
- Rest of the interview was simple and easy, contributing a new word and receiving feedback made sense

7.3.2 Admin Task List and Feedback

The final admin interview involved a user walkthrough with a task list. I recorded feedback for any difficulties experienced or any additional suggestions. Since I already asked admins about existing features in the last interview, I focused on the contribution system. Having interviewed a group of students who posted real contributions, the professors interacted with real contributions in the interview. I turned off email notifications so as not to bother the students who had contributed, and allowed professors to approve/decline contributions as they saw fit. Admin Task List:

1. Login
2. View Contributions
3. Choose one to review
4. Approve/decline with feedback

5. Repeat

Professor Buchholz:

- Likes the netid in the welcome message

- Should show the old feedback if you click on decline for revision more than once

    - Should populate the feedback form with the old feedback

- Block the contribution page once the word has been approved

    - He was able to go back to the page

- Overall good, really likes this system

Professor Maier Notes:

- Login was behind the three bar menu because of his window size, but he found it

- Likes the pending approval and pending revision after feedback

- Doesn't want to see approved/declined permanently in the contributions page! Perfect

- People have confusion with going back, don't think to use the browser

- Approval worked well, decline for revision worked well

- Couldn't edit the definition either, unexpected error - need to fix

- Edit works in normal upload

- FAQ is a good idea

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