

# **Developing and Studying Novel Sign Language Technology**

*A Major Qualifying Project (MQP)*

*Submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of  
requirements for the Degree of Bachelor of Science in User Experience Design.*

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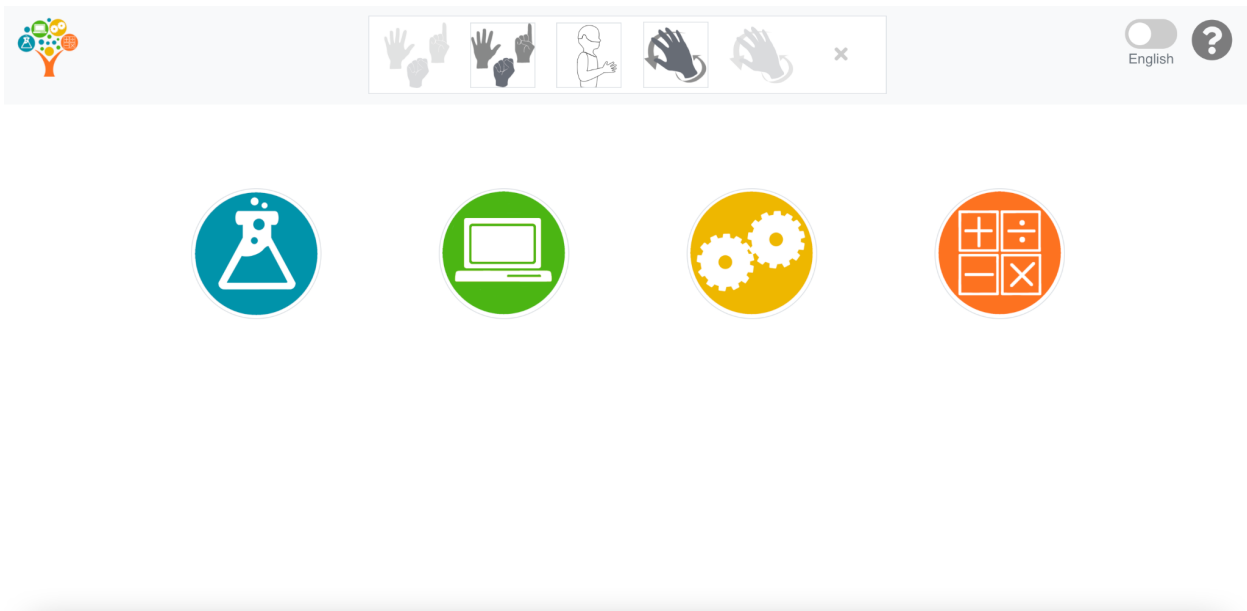
**Abstract**

As technology becomes more prevalent in society there is a need for it to become more accessible for different populations as well. Many resources online are accessible in English, however there are not as many resources in American Sign Language (ASL). This project specifically looks at questionnaire designs and how they can be implemented entirely in ASL. Having the ability to take a survey in one's primary language will help with accessibility, and this area currently is seeing a gap.

## 1.0 Introduction

Technology has become an increasingly prevalent part of society, especially with many companies and activities going remote during the COVID19 pandemic. With technology being an integral part of daily life for many, there is a need for accessible user interfaces (UIs). For those whose primary language is American Sign Language (ASL) there are a lack of digital resources that are primarily in this language. Many resources are written in English only. This creates challenges for ASL signers as they need to use resources in their second language.

Recently, there have been initiatives to create more resources in ASL, particularly for educational purposes. For example, the ASL Clear<sup>1</sup> is an online educational resource in ASL (Figure 1).



*Figure 1: ASL Clear Home Page. ASL Clear is an online education resource in ASL. When hovering over any of the four icons shown in the center a video with someone signing plays.*

However, there is a lack of standards for the design of such resources, and ASL has many characteristics that make it difficult to utilize standard practices of websites and technology resources that are primarily in a written language such as English. There is a need to work directly with ASL signers to better understand their needs, expectations and preferences with

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<sup>1</sup> <http://www.aslclear.org>



technology. However, standard practices for user-centered design and human-computer interaction research (e.g. user interviews, questionnaires, usability testing, etc.) need to be adapted to truly meet the needs of ASL signers. Specifically, it is important to remove any reliance on written language (e.g. English) in the research process as that could prevent some of the target users from fully participating in any of the user studies.

Thus, a goal of any research study with ASL signers could be to conduct studies in ASL. However, meeting the linguistic and cultural needs of the Deaf community in a well-designed research study requires significant additional effort when compared with designing a similar study in English. For example, recent work highlighted several challenges with creating questionnaires that align with ASL linguistic principles and cultural practices within the Deaf community. These challenges include survey platform tools; authorship, representation, and privacy concerns - with ASL the signer must be seen whereas in English the author may be less known; and video production considerations (Boll et al., 2020).

Building on that work, the goal of this major qualifying project (MQP) is to explore the unique needs, expectations and preferences of ASL signers related to ASL-centric questionnaires. Through an iterative design process, including prototyping, expert reviews, and a think aloud study, we identified important considerations when designing a questionnaire in ASL, and identified challenges and preferences that ASL signers have. With these findings, this work provides a foundation for researchers aiming to do research for and with the ASL-signing community.

### **Preliminary Formative Study: Understanding Deaf Experience with Existing Technology<sup>2</sup>**

Initial work on this project focused on a preliminary formative study to understand the Deaf experience with existing technology, in collaboration with the ASL Education Center. Interviews were conducted with five deaf participants in order to get a better understanding of their experiences and preferences with *ASL-centric user interfaces* as well as to elicit their feedback on an existing ASL-centric user interface, ASL Clear (Figure 1). The interviews were conducted fully in ASL. In addition, all participants completed a demographic survey with

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<sup>2</sup> The full details of this study are under review at the ACM SIGACCESS Conference on Computers and Accessibility (ASSETS 2021), and are summarized here.

questions about their general background as well as their experience and education related to ASL.

All interviews were recorded and transcribed and translated from ASL to English. The English transcript was then used for analysis. In addition, the original ASL videos were used by the ASL-fluent members of the team for analysis. To analyze the interviews we used thematic analysis. Thematic analysis aims to “identify patterns of meaning across a dataset that provide an answer to the research question being addressed” (Braun et al., n.d.). First, we familiarized ourselves with the interview transcripts and interview questions. Then we did an initial round of coding, which provided labels or categories for quotations within the interview. The codes identify important groupings that we can then go back to and review, and eventually use to develop themes. We individually went through the interviews to determine codes, then we all compared the codes we made as a team. From there, we compared and consolidated similar codes, and all added in the codes others had that we were missing. We then used this master list of codes to do another round of interview coding.

The interviews helped us get a better understanding of the perceptions deaf participants had of ASL-centric online resources. For example, it was challenging to accurately convey what was meant by an ASL-centric user interface. Other considerations included: language credibility, video placement and question layout, and navigation concerns.

In addition to building an understanding about the challenges and expectations of Deaf users with technology, this study uncovered several challenges related to conducting *ASL-Centric research*, which does not rely on English for any of the study procedures (e.g. interviews, questionnaires, etc.). In particular, this study revealed immense technical challenges and effort required to make study materials, such as questionnaires, that are linguistically and culturally appropriate for ASL signers and that also provide a positive user experience. This work motivated the development of the ASL-centric questionnaire for this MQP.

## **2.0 Background**

### **2.1 American Sign Language (ASL)**

ASL is the primary language of many deaf people in the United States. While this project focuses on ASL, there are other signed languages as well. For example, there is British Sign Language, French Sign Language, Chinese Sign Language, and Irish Sign Language, among

others (Brooks, 2020). Each of these has different origins and influences. Signing Exact English (SEE) is another type of signed language that uses many of the same signs as ASL, however follows the grammar structure of English (Rendel et al., 2018).

ASL is expressed through hand movements, gestures, and facial expressions. It “has the same linguistic properties as spoken languages, with grammar that differs from English” (*American Sign Language* 2020). For example, ASL has a different grammatical sentence structure than English. In ASL, sentences are structured the following way: time (tense) + topic (subject) + comment (what is being said about the subject) + referent (refers to subject). For example, in English a proper sentence would be “I am going to school” whereas in ASL the same sentence would be structured as SCHOOL GO I. Another important aspect of communicating in ASL is facial expressions and body language. Facial expressions emphasize what is being said, and can change the meaning of the sentence. Body language and location of the sign can also change the meaning of a sign. These elements are essential linguistic aspects.

Having resources in ASL is important, especially as technology becomes an increasingly prevalent part of life. Being able to use resources in one’s primary language increases accessibility.

## **2.2 Questionnaire Design in ASL**

Currently, there are limited resources for easily creating ASL questionnaires, and thus they are not widely used. Boll, et al. revealed several challenges and gaps in accessibility for ASL-Centric questionnaires, including representation and signer privacy concerns, adaptability of audio-centric design tools, video production, and survey platform tools (2020). Graybill et al. (2010) emphasized the translation efforts needed when developing ASL-centric questionnaires. They noted that there are not always direct translations between English and ASL, which presented challenges. Another difference between ASL and English they noted was that, for example, in ASL the sign for “drink” is dependent on the type of beverage, whereas in English the one word “drink” is used (Graybill et al., 2010).

Best practices and standards exist for the structure and design of English-centric questionnaires, however not for ASL-centric questionnaires. Many survey tools are designed for written languages and their features reflect this. This creates an added level of difficulty for designing any questions in ASL. ASL-centric questionnaires would be comprised of videos, and

may introduce loading issues based on internet speeds as videos take longer to load than written text. Informally, from the study described in Section 1, we found numerous additional challenges, which motivated us to study ASL-centric questionnaire design more formally in this MQP.

### **3.0 Project Goals**

The goal of this project was to identify the requirements and challenges associated with creating and administering an ASL-Centric questionnaire. To do this, I developed a survey in ASL with representative question types in order to get feedback from ASL signers about what does and does not work well, and to provide guidance for future questionnaire designs. This was done through developing a survey through an iterative user-centered process and receiving formative feedback through a think aloud user study. From there, I was able to come up with a set of future recommendations on the types of questions that could work best and formatting guidelines.

### **4.0 Towards Culturally and Linguistically Appropriate Questionnaires for the Deaf Community**

To develop this survey we looked at both the previously developed demographic survey and the interviews conducted (Section 1).

#### **4.1 Background**

This project was motivated by a preliminary study described above in which a demographic survey was created in ASL for a research study with Deaf participants. That project, along with this MQP, was completed in collaboration with the ASL Education Center, a team that includes native ASL signers and are experts in ASL education. In that study, both the researchers and the study participants found the demographic survey to be problematic due to a number of usability and technical challenges. Thus, this project aims to address many of the shortcomings. This survey was used for reference, and its questions were used as examples since they are real-world, commonly used demographic questions that have wide applicability.

## **4.2 Goals**

The main goal of the study was to determine what types of questions would work well in ASL and what challenges emerge. A representative set of question types was chosen in order to get feedback on different formats. The focus of the survey was not on the questions or the answers to them, but on how ASL-signers interacted with the questions and its formatting.

## **4.3 Procedure Overview**

The survey was designed through an iterative user-centered process, and was done in collaboration with ASL experts at the ASL Education Center. The ASL Education Center is made up of a team of Deaf Education experts who are fluent in ASL, and who are part of the Deaf community. These collaborators were essential to this project, as they could provide appropriate ASL content, as well as expert feedback on the cultural and linguistic appropriateness of various parts of the design. Once we had a final design, we conducted a think aloud study (Section 5). These steps of our iterative process are detailed below.

### **4.3.1. Question Selection and Refinement**

From the demographic survey (Section 1) we reviewed all of the questions and categorized them as either rank 1, 2, or 3, where 1 is most important to include and 3 is least important to include. Questions with a ranking of 1 were most likely to be included, 2 meant we were to have more of a discussion about them as a team, and 3 meant that it did not need to be included as they did not apply to the goals of the new survey. We wanted to include basic demographic questions, such as age, but the original demographic survey had many questions relating to education and teaching which was not applicable in this new context. The WPI team went and made the initial rankings, then we went over them with our collaborators at the ASL Ed Center and adjusted accordingly based on their recommendations.

After looking at the demographic questions, I took the original interview questions and began reformatting them to work in a survey. This involved determining the appropriate question type as well as rewording the questions to be close-ended for a survey. Once the questions were drafted we reviewed them with our ASL expert collaborators at the ASL Ed Center and narrowed down our survey goals. We determined that a subset of the questions could be cut out from the

survey as they would be better suited for a usability study. This was an important step as one complaint from the original demographic survey was that it was too long and time consuming.

User study - remote live 1) Design UI (perhaps 2 options) 2) Give tasks, screen record, note where users succeed and struggle	How comfortable were you with the speed of the videos? Would you like them to be faster or slower? Would you want to control the speed yourself?		*measurements of speed for videos? mc with options. *Likert scale, how comfortable were you with the speed of this video? -- scale of too slow to too fast
	Would you want the videos to keep looping or stop after they are over or when you are not playing them?	*yes or no question, can ask as is	
	When a video is not being played, an image appears as a still frame in place of this video. Would you want the cover to reveal more details about what the video contains? What should the still frame of the video contain, in order to be most descriptive?		*can ask first part of this question as yes or no. maybe ask if this is helpful? **can we integrate this into the answer choices? *When a video is not playing, how important/helpful is what it is paused on? *freeze frame of start of sign, freeze frame with english caption, doesn't matter what it is paused on?
	Would you want to see more color in the videos? For example, the background of the signer can be of a different color for saying "Confirm" and "Cancel" (it is often green and red respectively)	*would color help in differentiating topics?	*show example(s) and ask for opinion?
	If you are working on a laptop, how many videos per screen would you consider to be comfortable? On a mobile device? Other?	*If working on a laptop, how many videos per screen (per page) would you consider comfortable? *If working on a mobile device..? -MC with range? A. 1-2, B. 2-3, etc.	
	What arrangement of videos on the screen would you prefer on a laptop? On a mobile device?		*show two options and ask? But then do we need a question in the survey on what device they are using to take it? Maybe cut this question..?

Figure 2: Questions determined to be better used in a future Usability Study

The questions were categorized based on what they are related to. We decided on technology usage, language preferences (ASL, English, or Bilingual), perceived benefits or drawbacks, and ending with the demographic questions.

#### 4.3.2. Design of ASL-Centric Individual Questions and Answers




Once the questions were determined, I chose a few representative questions of different types to begin working on the layout in ASL. The reason behind doing this is so we can determine which format works best with a smaller number of questions and from there this can be applied to the larger survey overall. To begin, I made an English version of the survey in Qualtrics and presented it to both the WPI team and ASL Ed team for feedback.

Based on the initial review, adjustments were made to the question about participant age, so that it is not multiple choice. Written numbers are acceptable input and do not require mastery of the English language. This helped make the survey shorter.

Additional feedback led to the decision to make Likert scale question responses appear horizontally rather than vertically, as in ASL it makes more sense to go left to right. Based on the feedback from experts, I drafted the initial version of the ASL survey.

Q2 For each item, specify how frequently you use them.

⚙️  
iQ

	Rarely	Once a Month	Once a Week
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

*Figure 3: Sample of Technology Usage question. Before recording the ASL videos, placeholder videos were included to focus on formatting. Once the formatting was established the ASL videos were put in.*

We selected Qualtrics as a questionnaire platform since it has extensive functionality for various types of questions and customization, as well as analysis tools for the responses. The videos with the questions and answers in ASL can be embedded into Qualtrics survey tools.

However, adding the videos led to some challenges. For one question, the matrix grew to be too big and was overwhelming visually. After reviewing this with the WPI and ASL Ed teams, we determined that we needed to reformat it. For the matrix question we narrowed it down to four videos across horizontally and six videos down the vertical axis. This enabled all videos to be seen horizontally so the matrix would load properly. However, there were some

initial issues where on some screens and devices the matrix would load vertically, which defeats the purpose. In Qualtrics, the settings were adjusted to make it so the survey took up nearly the full width of the screen, with some padding on the sides. This helped the matrix to properly load, but for some users they may still need to adjust the zoom settings within their browser windows for it to show up.

#### **4.3.3. Expert Review of Questionnaire Prototype**

The survey went through many iterations once the ASL videos were put in. The initial recordings were made and then put into Qualtrics. Once that was completed, the survey was reviewed by both the WPI and the ASL Ed team for usability issues. There were issues that came up regarding formatting on different user's computers. The survey looked different based on browser window size, how zoomed in the browser window was, and the screen size of the user's computer. The survey was designed to work on desktops or laptops. It will not format correctly on mobile devices as the screen is too small.

For the first version of the survey, the videos were uploaded to YouTube and then embedded into Qualtrics. This method led to extremely long load times and rendered the survey unusable. After seeing the videos in the survey format the team also noticed that some of the videos did not make sense or were unclear so they needed to be re-recorded. During the second round of videos we also compressed them so they were smaller. The goal with this was that they would hopefully load faster since they were smaller videos.

For the next iteration of the survey with the new smaller videos, we uploaded them via Qualtrics rather than YouTube. While they loaded slightly faster, they still took a considerable amount of time to load. The benefits of using Qualtrics to load the videos is that they do not have ads or recommended videos show up. This version of the survey was still not very usable so we made another version, as there were still videos that needed to be redone. We had tried to incorporate a green screen in the recordings as we thought it would make the videos easier to follow, but it actually made them harder to see and sometimes the signers hands would appear blurry. This then led to our next iteration of the survey.

In the final version of the survey we went back to YouTube to embed the videos. With the smaller video sizes, the survey was able to load faster. In this version we also put all of the questions on one page, rather than having a separate survey page for each question. This way all



the videos were able to load at the beginning, instead of having to wait every time the user moved on to a new question.

Through the iterative design process we also decided to include icons in question 3. The ASL Ed team discussed that icons were becoming more common and helped to represent what is being signed. The goal of the icons was so that users would not have to rewatch the video to remember what it was saying; they would be able to look at the icon for reference and recall what the sign was in the video.

#### 4.4. Results: Final Questionnaire

The final questionnaire consisted of an introductory video explaining how the think aloud user study would work and 8 questions to follow: two matrix questions, one multiple choice single answer question, two Likert scale questions, one multiple choice multi-select question, one fill in the blank, and one hot spot. The complete survey can be seen in Appendix A.

#### Question 1 - Setting up the survey and starting the think aloud study:

To begin the think aloud study, participants watched an introductory video explaining how the survey and think aloud would work. It walked through an example think aloud as well. The example task was to count the number of windows in their childhood home. The purpose of this was so participants could familiarize themselves with expressing their thought processes while answering questions.

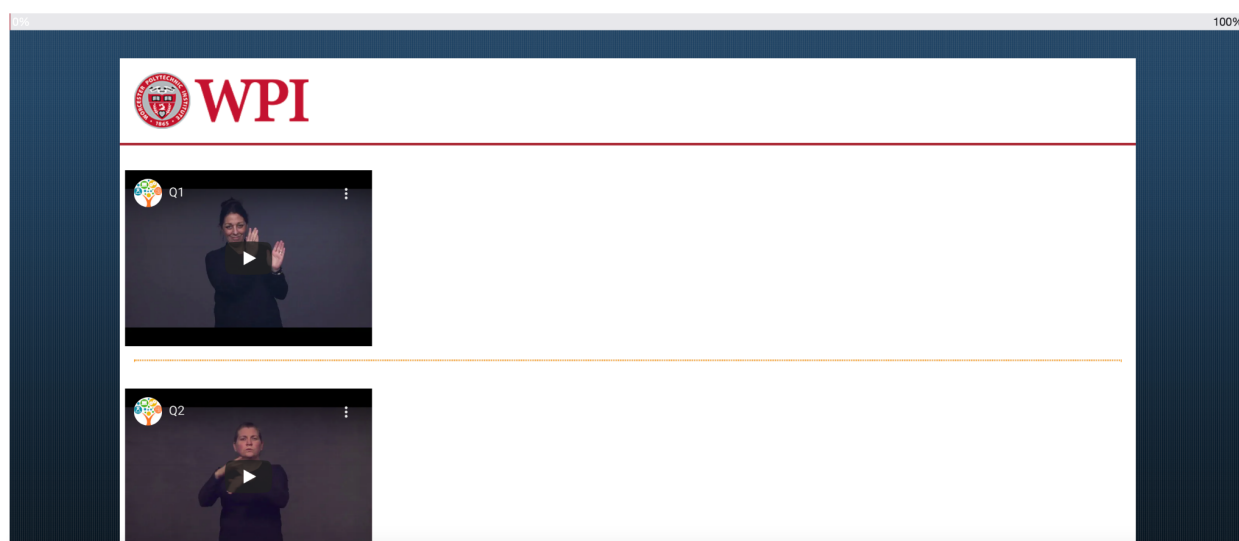
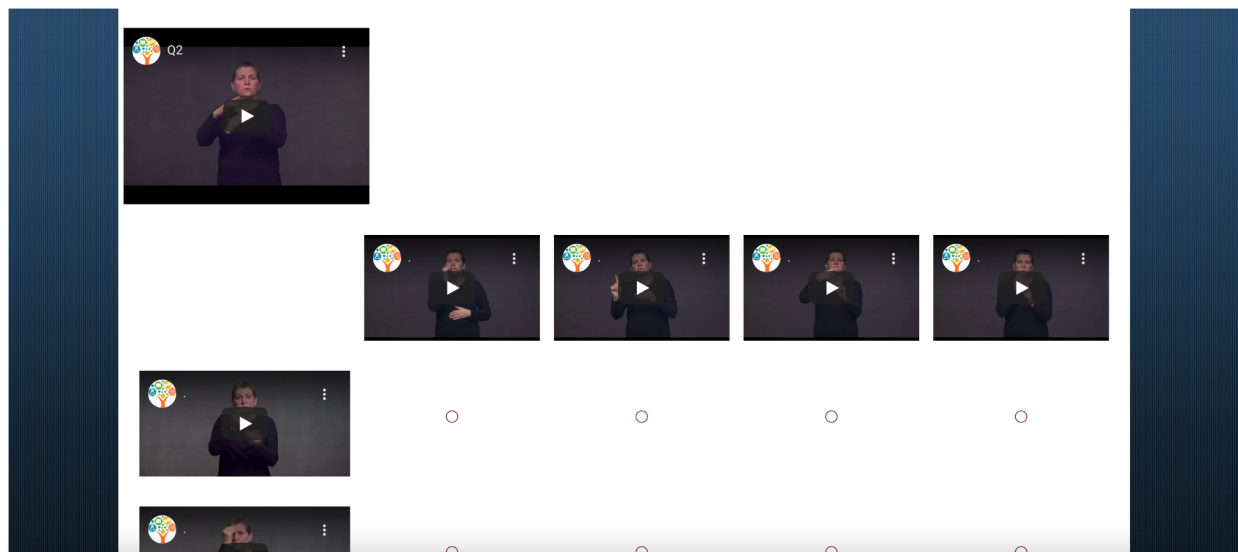


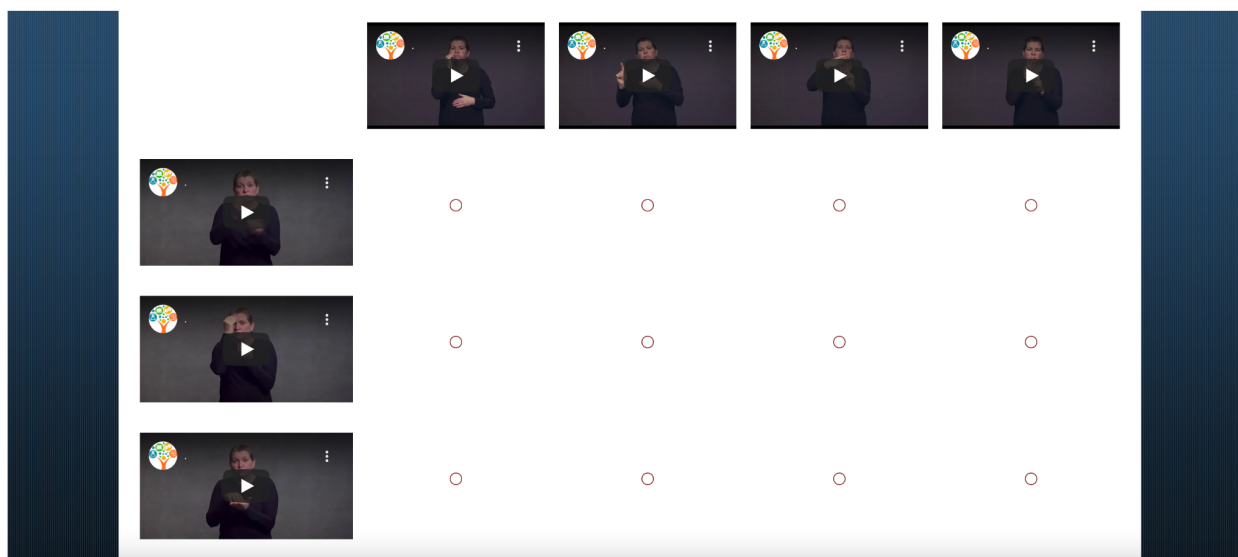
Figure 4: Question 1 - Introduction to the Think Aloud

## Question 2 - How often do you use the following resources in ASL?

Question 2 asked users how often they use the following resources in ASL. The question was formatted as a matrix. Below are screenshots of the question in the survey.



*Figure 5: Question 2 - How often do you use the following resources in ASL?*



*Figure 6: Question 2 - answer choices*

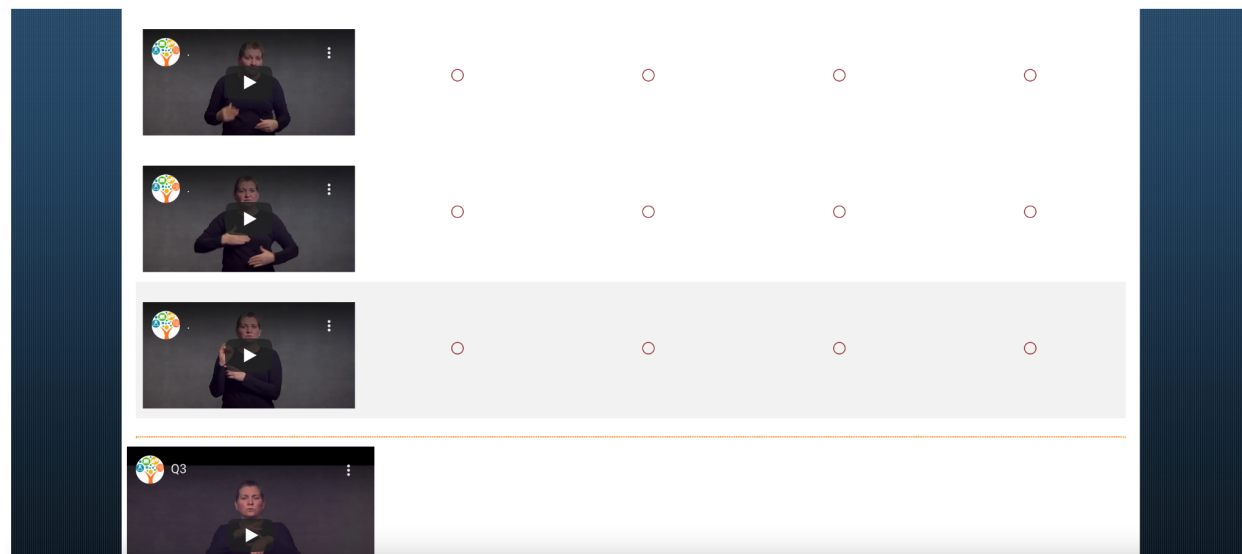


Figure 7: Question 2 - answer choices continued

### Question 3 - How often do you use these resources in English?

Question 3 uses the same format and answer choices as question 2, but with two key differences: the question asks about English instead of ASL, and each of the videos includes an icon that represents what is being signed in each video.

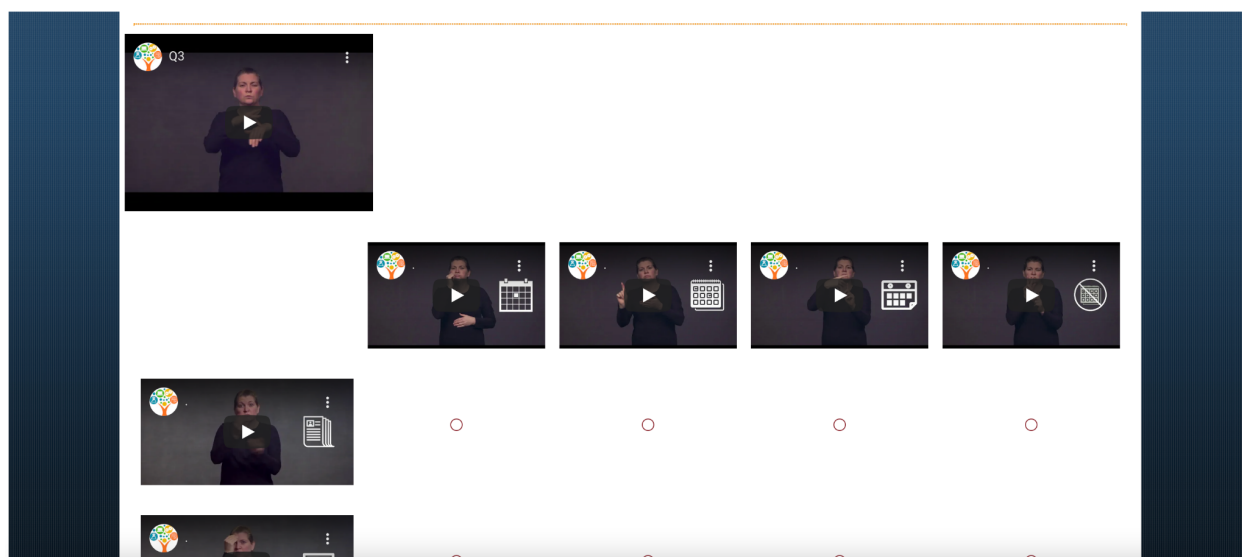


Figure 8: Question 3 - How often do you use these resources in English?

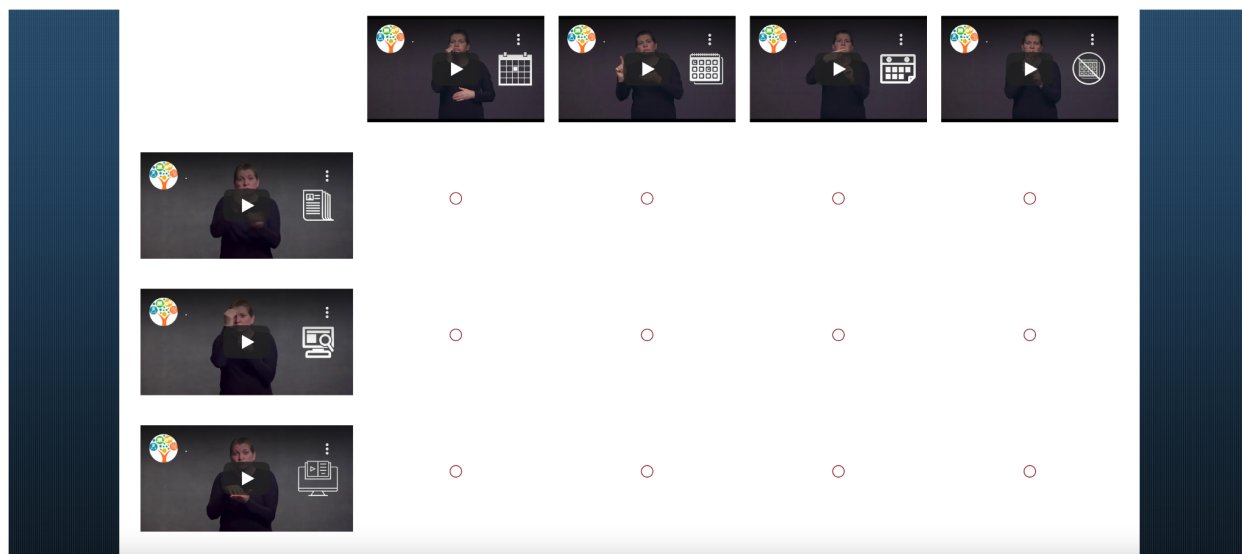


Figure 9: Question 3 - answer choices

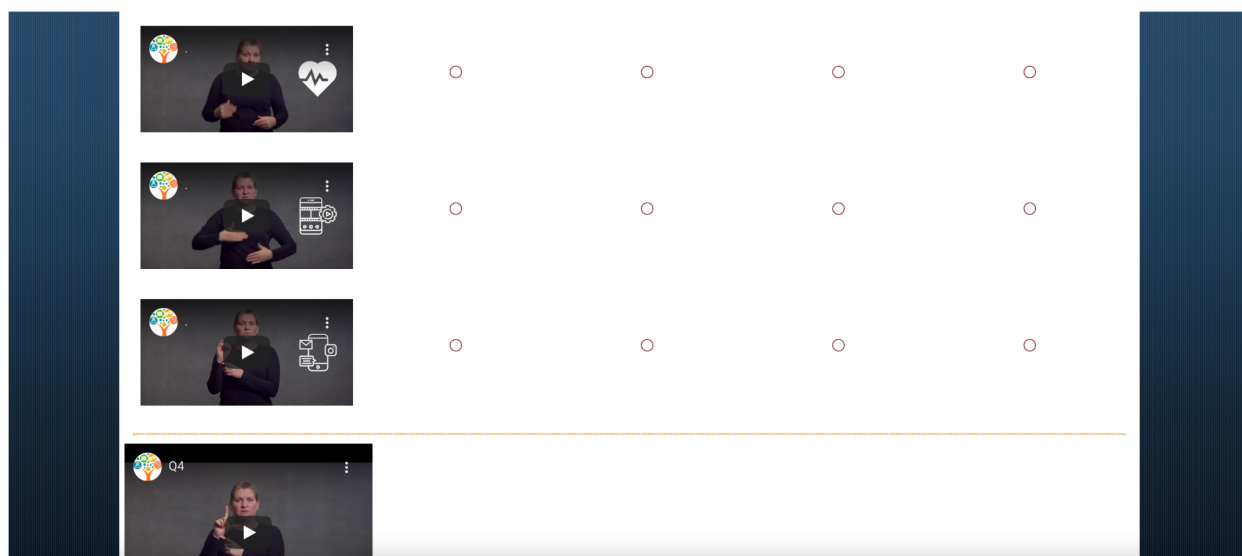


Figure 10: Question 3 - answer choices continued

#### Question 4 - Which of the following resources would you like to see in ASL?

Question 4 took the format of a “check all that apply” multiple choice question. It asks “which of the following resources would you like to see more of in ASL?” and had the same

answer choices of resources as in questions 2 and 3.

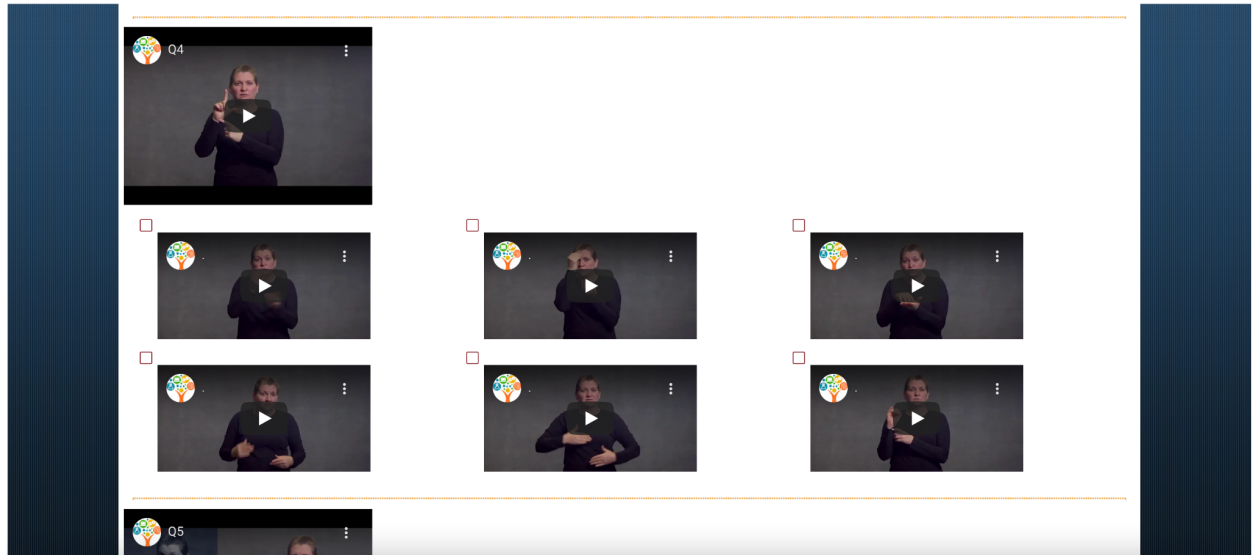
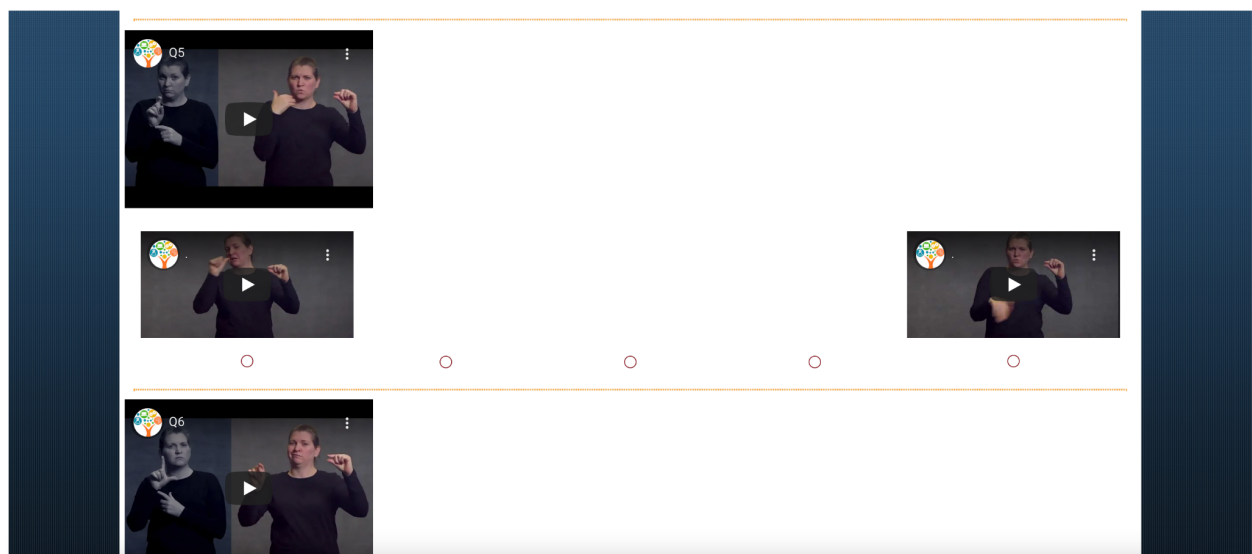


Figure 11: Question 4 - Which of the following resources would you like to see in ASL?

**Question 5 - When thinking of an ASL-centric User Interface, how important is it to be able to adjust the speed of the video? ASL-centric User Interfaces refers to electronic media that is primarily in ASL, rather than written English for example.**

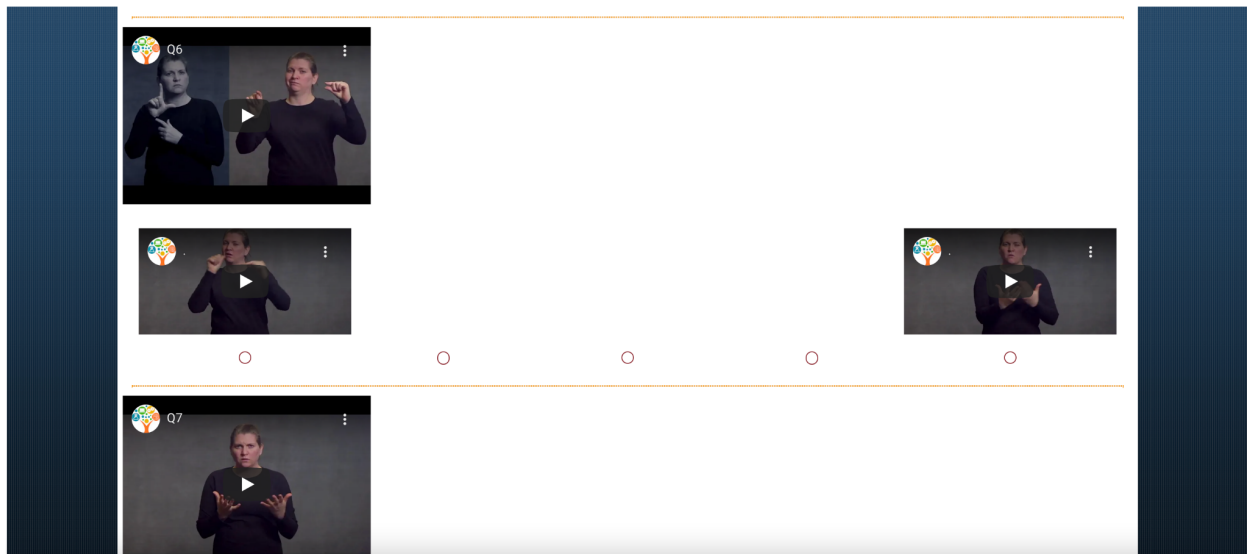
Question 5 was a likert scale question, with the two ends of the scale being extremely unimportant and extremely important. The question asked about ASL-centric user interfaces and also provided a definition of what that means so the participants understood what that refers to.



*Figure 12: Question 5 - When thinking of an ASL-centric User Interface, how important is it to be able to adjust the speed of the video? ASL-centric User Interfaces refers to electronic media that is primarily in ASL, rather than written English for example.*

### **Question 6 - How comfortable are you with ASL?**

Question 6 followed the same format as question 5. It was a likert scale with the two end extremes being extremely comfortable and not comfortable.



*Figure 13: Question 6 - How comfortable are you with ASL?*

### **Question 7 - What is your current age? Please type in a number.**

Question 7 took the form of fill in the blank and asked: What is your current age? Please type in a number.

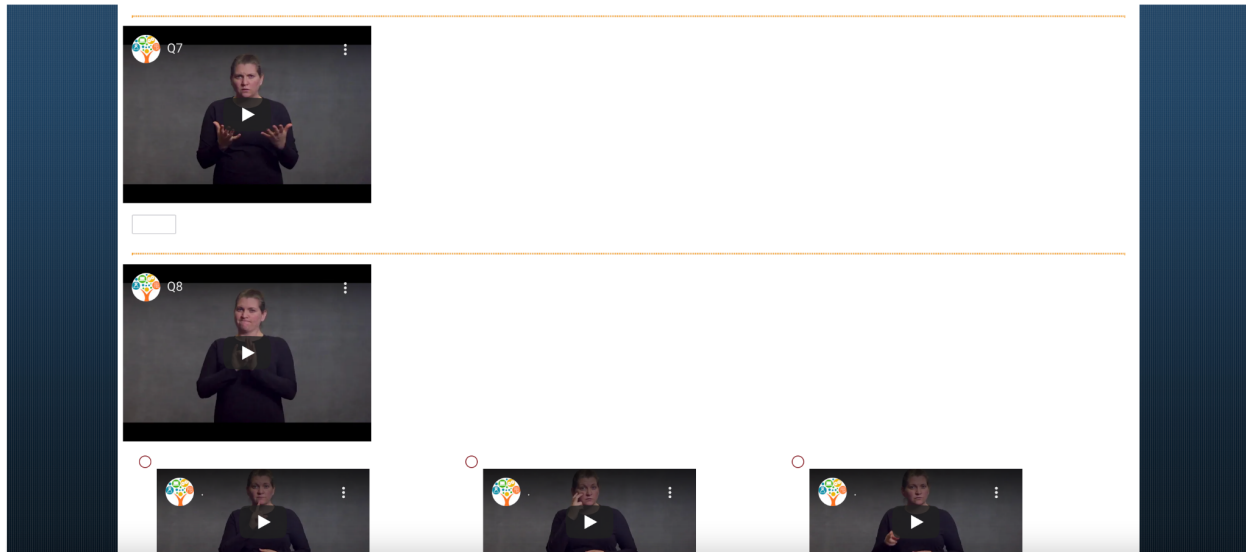


Figure 14: Question 7 - What is your current age? Please type in a number.

**Question 8 - Which of the following best indicates how you identify yourself?**

Question 8 was a multiple choice question with six answer choices formatted in two rows.

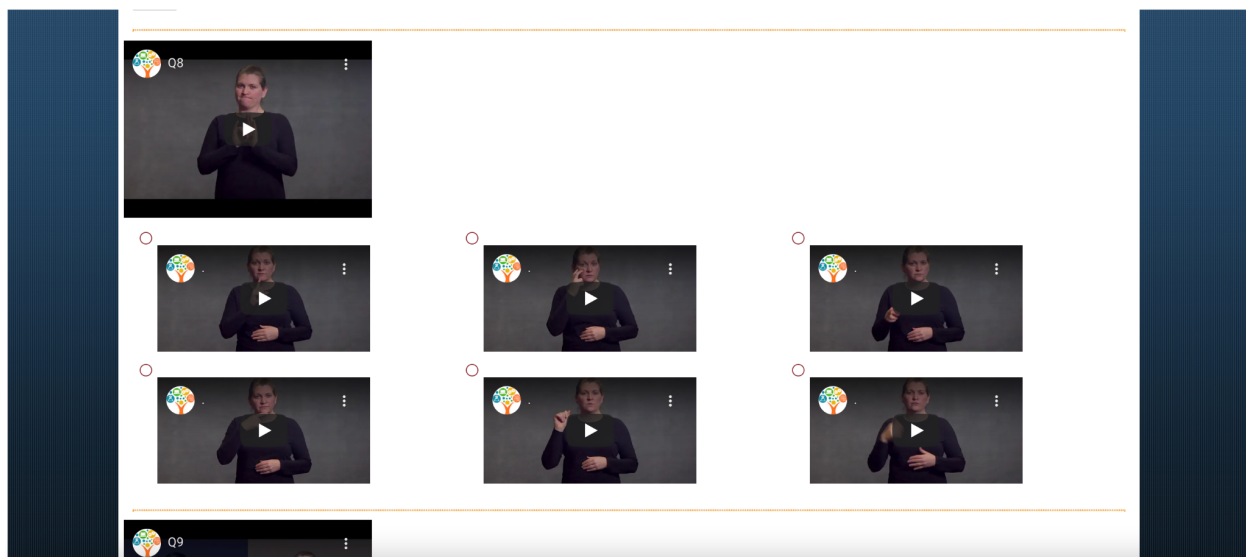
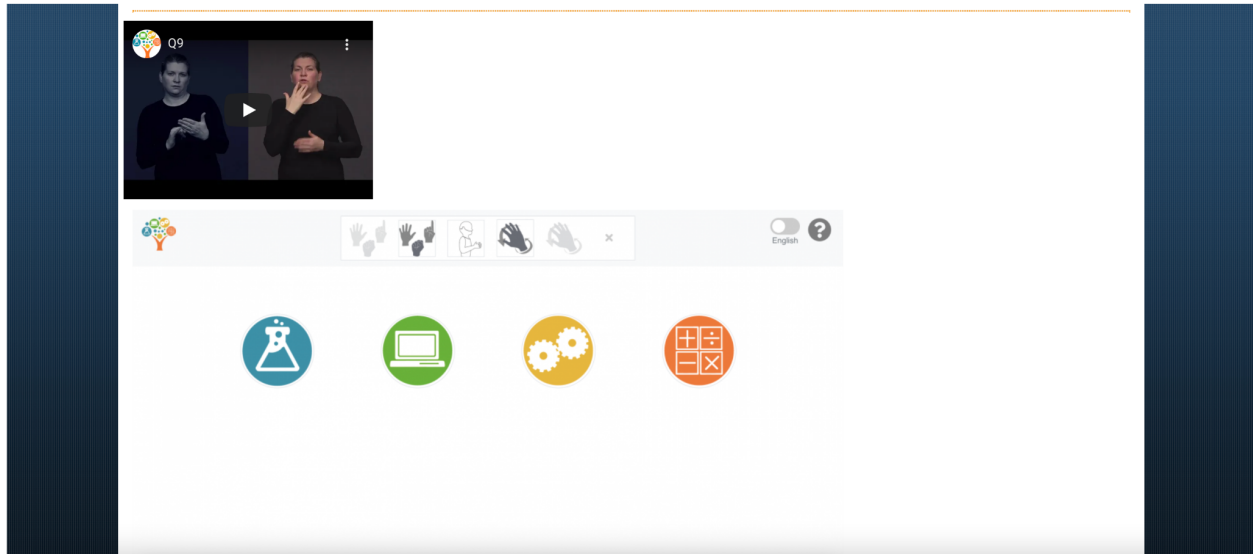


Figure 15: Question 8 - Which of the following best indicates how you identify yourself?

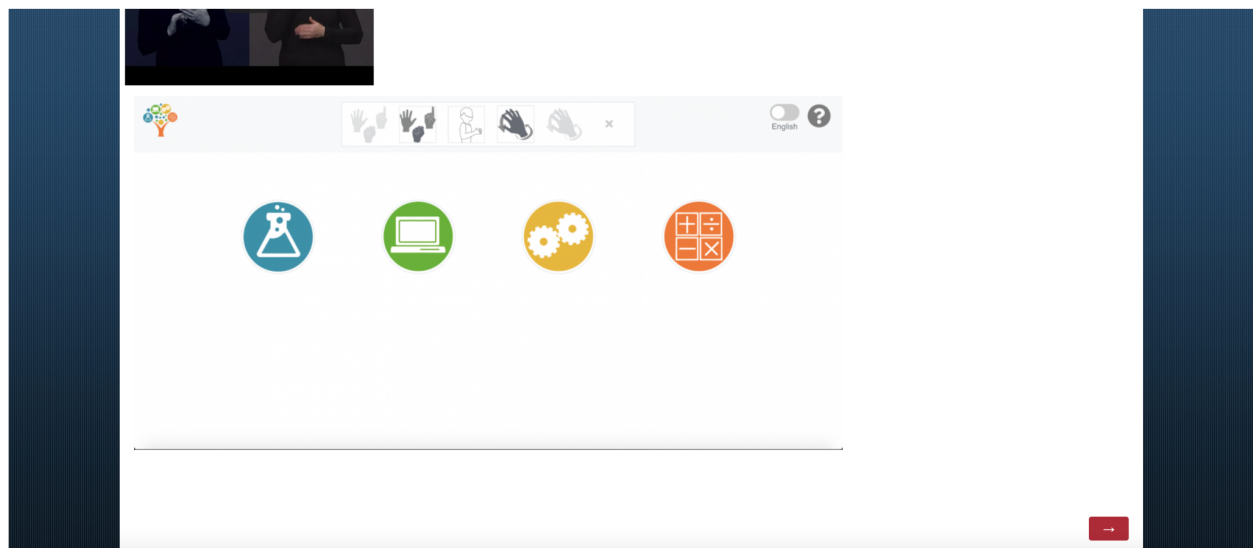
**Question 9 - What do you like or dislike about the following webpage? Click once on an area if you like it, and it will turn green. Click twice if you do not like it and it will turn red. Click a third time to clear your response for the selected area.”**



Question 9 utilized the hotspot format on Qualtrics. Hotspots were identified on a screenshot of a page from ASL Clear. Participants were to click on each area of the page and say if they liked it or not.



*Figure 16: Question 9 - What do you like or dislike about the following webpage? Click once on an area if you like it, and it will turn green. Click twice if you do not like it and it will turn red. Click a third time to clear your response for the selected area.”*



*Figure 17: Question 9 and end of survey*



## **5.0 Think Aloud User Evaluation**

### **5.1. Goals**

To test the survey we conducted a think aloud. A think aloud study consists of participants completing a task while simultaneously explaining their thought processes and why they are making certain choices. The goal is for researchers to understand why users behave in certain ways in order to identify usability issues.

During the think aloud study, participants completed the ASL-centric survey (Section 4). The goal of this think aloud study was to get participant feedback on the survey itself and the format of the questions. The intent was not to focus on the answers given to the questions, but to identify preferences and challenges in answering questions in an ASL-centric questionnaire.

### **5.2. Procedure**

Each think aloud was conducted by one participant and one researcher from the ASL Ed team. The think alouds were conducted virtually over Zoom and in ASL. The first question on the survey was an introductory video describing the think aloud protocol so as to keep it consistent for each participant. It explained what a think aloud is and that participants were expected to sign what they were thinking as they took the survey. Researchers were not to answer any of the participant's questions once the think aloud began. Once the think aloud concluded, a brief demographic survey was given to the participants to take in English and was not part of the think aloud study.

Interpreters voiced over the think alouds in English and developed a written English transcript. To analyze the think aloud results, usability aspect reports (UARs) were created, which included: the usability issue identified, an explanation of the issue, evidence from the participants regarding the issue, the severity of the issue, and potential solutions. The severity is ranked on a scale of 1 to 4, where 1 is not urgent but would be good to fix and 4 is an issue that urgently needs to be fixed. To develop the UARs I watched the recordings of the think alouds with the voice over, while also looking at the transcript for confirmation on any points.

### 5.3. Participants

Participants were recruited through a convenience sample of those in the ASL Ed Center team's network. There were a total of 8 participants, but one Zoom video recording did not capture the signing participant, and so that participant's data is not included.

**Table of Participants**

ID	How comfortable are you with comprehending ASL?	How comfortable are you with expressing yourself in ASL?	How comfortable are you with reading English?	How comfortable are you with writing in English?	At what age did you become deaf or hard of hearing?	At what age were you first exposed to ASL?	Where did you first encounter sign language?	Race/Ethnicity
1	Extremely	Extremely	Extremely	Extremely	Born	15	Parents	White
2	Extremely	Extremely	Moderately	Slightly	Born	5	Class: K-12	Black/African American
3	Extremely	Extremely	Extremely	Extremely	Born	0	Other family	White
4	Moderately	Extremely	Moderately	Moderately	5-10	38	Class: K-12	Latino
5	Extremely	Extremely	Extremely	Extremely	Born	22	Other	Black/African American
6	Extremely	Extremely	Slightly	Slightly	Born	3 months	Parents	White
7	Extremely	Moderately	Moderately	Neither comfortable nor uncomfortable	1-4	5	Class: K-12	Black/African American

*Table 1: Participant demographic information.*

### 5.4. Results

The results from the think aloud user study take the form of UARs. As mentioned in Section 5.2, each UAR identifies a usability problem and provides related evidence from the think aloud. Below is a detailed list of the UARs identified, their corresponding evidence, the severity level of the problem, and a proposed solution.

**ID:** "TA-01"

**Name:** Questions are too vague

**Evidence:** Participant 1 commented Q2 was vague and had to rewatch Q5 video to understand the question. Q6 feels as if information is missing from the question and is too vague to answer, and Q9 was too confusing to understand so they did not answer that question. Participant 2 seemed to misunderstand the entire survey and did not answer the questions. Participant 2 was confused on what the questions were asking. Participant 3 was not sure what the videos were for at first and suggested words would help. Participant 5 said Q2 and Q3 need to be rephrased because they did not make sense. The questions need to include more information. Participant 6 misunderstood Q2, Q3, Q4, and Q9.

**Explanation:** Unclear what the questions are asking and how they correlate to the answer choices

**Severity:** 3 - all participants commented that at least one of the questions was confusing and needs to be elaborated on more.

**Solution:** Add more detail to the questions. Include how to answer them as well and incorporate the format of the question into the question video. Question should be related to the answer choices and format matters.

**ID:** "TA-02"

**Name:** Answer choices are too short/vague

**Evidence:** Participant 3 said they were unsure of what the answer choices meant and that they were too vague.

**Explanation:** Need to correlate the answer choices with the question.

**Severity:** 3

**Solution:** Explain the answer choices more and correlate them to the question. Provide specific explanations, rather than one word responses.

**Relationships:** TA-01, TA-08, TA-10

**ID:** "TA-03"

**Name:** Control of Video Speed

**Evidence:** Participant commented depending on the context of a video they would want to be able to control the speed.

**Explanation:** Video speed depends on the goal of the video. Too hard to answer otherwise.

**Severity:** 1

**Solution:** Add in the option to control the speed of the video for more complex topics.

**ID:** “TA-04”

**Name:** Matrix Loading

**Evidence:** To get the matrix to properly show up on participants’ screens they needed to adjust their browser window and zoom out within the browser. Participants 2, 3, and 7 had to zoom out their browser windows in addition to making it fullscreen.

**Explanation:** The matrix questions take up the most screen space. If the user’s screen is too small Qualtrics puts it in a vertical format, which is not the desired way to go through the survey. The setup required for the matrix was frustrating for users and confusing.

**Severity:** 4

**Solution:** Limit the number of videos included in the answer choices of the matrix. Make the top row sticky so it can always be seen when users are looking at the vertical column so they can better match their answers.

**ID:** “TA-05”

**Name:** It takes a long time to go through all of the videos for each question

**Evidence:** Participant 1 commented that it took a long time to go through the survey since they had to watch every video. They wanted to make sure they were not missing any information but were unsure if others would take the time to go through every video. Participant 2 said the survey was too long and was overwhelming.

**Explanation:** English text can be skimmed, however videos cannot, which makes the survey take longer as each video must be watched all the way through. Then users need to remember what each video represented or they have to watch it again.

**Severity:** 3

**Solution:** Potentially incorporate better icons or combine videos where possible.

**Relationships:** TA-10

**ID:** “TA-06”

**Name:** Videos are too small

**Evidence:** Participants 2 and 3 put many of the videos in full screen and commented that the videos should be larger. They attempted to watch some of them at the size they were however they stated multiple times that they were too small to see. Participant 3 adjusted the quality of the video during Q1 because they said it looked pixelated and low quality

**Explanation:** The user had a hard time seeing the videos and needed to make the fullscreen in order to properly see them, which was frustrating.

**Severity:** 3

**Solution:** Increase the default video size, or provide options for setting the user's preferred video size at the beginning of the survey.

**Relationships:** TA-11

**ID:** "TA-07"

**Name:** Signer Considerations

**Evidence:** Participant 2 noticed that the background in the videos of the signer changed from tan to brown, which confused them. They also said that the signer has very clear ASL language usage. They said they are a good language model for people who want to learn. They said the signer's emotional tone matched the comments. They thought the video seemed choppy and not smooth. They also commented on the signer's earrings and liked them.

**Explanation:** Background and the signer can affect the clarity of the videos and information being conveyed.

**Severity:** 3

**Solution:** Choose a background that is not distracting and make sure the signer can be clearly seen at all times.

**ID:** "TA-08"

**Name:** Signs Used

**Evidence:** Participant 2 asked for clarification of what a sign meant in the Q1 video. They also commented that the sign used for resources was new to them and was a sign they had recently

learned as they had originally thought it meant something else. They suggested examples were given to clarify what some of the signs are.

**Explanation:** Not everyone has the same vocabulary of signs and some signs may be regional, which should be taken into consideration when making a survey.

**Severity:** 3

**Solution:** Use well-known signs. Add in examples or explanations in the videos rather than just signing one word.

**Relationships:** TA-02

**ID:** “TA-09”

**Name:** Icons are unclear

**Evidence:** Participant 2 said that the icons do not match up with what the sign is they are supposed to be representing and felt they were unclear. Participant 3 was initially surprised by the icons and said they give a rough idea of what the video will say, however did not appear to think they were very helpful or clear.

**Explanation:** The user was frustrated that the icons did not match up with what the sign was and wanted them to be more realistic and match up better.

**Severity:** 2

**Solution:** Design icons that better match the sign and are more realistic. Look into commonly used icons for certain industries, for example.

**Relationships:** TA-12

**ID:** “TA-10”

**Name:** Matrix is confusing to understand and not intuitive

**Evidence:** Participant 3 was confused by the matrix and was not sure how to answer it. They felt very lost and did not understand the question until after watching all of the videos in the matrix, but due to this had to then rewatch them. Participants 5 and 7 were also confused by the matrix and did not understand how to answer it. Participant 7 eventually figured out how to answer the question once watching all the answer choice videos.

**Explanation:** The matrix question appears overwhelming as there are a lot more videos than in the other questions, and it takes up a lot of screen space. There are a lot of videos to watch and it is not immediately clear how they correlate with each other.

**Severity:** 4 - this question confused every participant and is not an ideal format for ASL-centric surveys.

**Solution:** Limit the number of videos included in the answer choices of the matrix. Make the top row sticky so it can always be seen when users are looking at the vertical column so they can better match their answers. Participant 3 recommended adding English captions or text.

**Relationships:** TA-05

**ID:** "TA-11"

**Name:** Video Platform Considerations

**Evidence:** Participant 3 stated that YouTube was not ideal for this purpose, but did like that with YouTube the speed of the video can be adjusted. They did not like that they had to click play and suggested that a gif may be better.

**Explanation:** It takes a lot of clicks to watch each video for all of the questions which takes up time and effort.

**Severity:** 2 - a different format would be better but it does not stop the survey from being taken.

**Solution:** Try to implement gifs or a video platform that has only the buttons and tools needed by the user.

**Relationships:** TA-06

**ID:** "TA-12"

**Name:** Likert scale question unclear

**Evidence:** Participant 4 was initially confused on how to approach the likert scale question. They also commented that they felt the video was incomplete or cut off, which further confused them. Participant 5 was not clear on the instructions provided to answer this question.

**Explanation:** Participants were confused by the likert scale question and that only the two ends of the scale were labeled, rather than all radio buttons.

**Severity:** 2

**Solution:** More clearly label the ends of the scale, or label each option choice.

**ID:** “TA-13”

**Name:** Hotspot question is unclear

**Evidence:** Participant 1 did not understand the question and did not attempt to answer.

Participant 2 did not realize they could click on the image and had to be prompted by the interviewer. They also did not understand the question. Participant 5 was confused as to the point of the question and did not know what the resource was in the screenshot for the hotspot.

Participants 4 and 6 did not realize there were multiple areas to click on in the hotspot.

Participant 3 only thought the icons were clickable, but not other areas of the image. Participant 7 did not understand how to answer Q9. They had to rewatch the question video but were still confused.

**Explanation:** The user did not understand the question type and was unsure of how to answer.

**Severity:** 4 - this type of question either should not be included or needs to be explained better with more explicit instructions.

**Solution:** Be more clear in the question format as well as with what type of feedback is being looked for.

## 6.0 Discussion

Overall, participants seemed interested in ASL-centric resources and would like to see more of them, as they felt there was a lack of ASL resources and it can be improved. There are some important considerations to take when designing an ASL-centric survey, which are outlined below:

### Question Formats

In the survey we tested the following question types: matrix, select all that apply, multiple choice, likert scale, fill in the blank, and hotspot. Below, each is described to identify the user response and effectiveness of each question type.

1. The matrix questions presented a few challenges. They get very big very quickly, as videos take up much more screen space than written English text does. Participants commented that it was overwhelming and difficult to follow. In the future it would be



beneficial for the top horizontal row to be sticky so it can always be referenced while scrolling through the options in the column to the left. This question is also time consuming as there are a lot of videos to go through and participants need to remember which ones represent which answer choice.

2. Select all that apply and multiple choice seemed easy for participants to follow. The biggest comment was that there were too many videos to watch.
3. Likert scale questions led to some confusion for participants. We only included videos on the far ends of the scale, but not over the middle options. This could be something to test in the future to see if it made it easier for users to understand.
4. The fill in the blank question was included to ask for participant age. The participants were able to answer this question relatively quickly. In the question video they were instructed to type their age in the box which helped as this was an explicit instruction. The point of the survey is to be completely ASL-centric, however since it was only numbers being typed and there was no English to be written we decided to include this format.
5. The hotspot question was met with confusion by all of the participants. This question could be good if looking for very specific feedback, but the image being used needs to be very clearly explained. Participants could figure out how to click, but many did not realize there were multiple areas they could click on so this needs to be explicitly stated in the future. There also needs to be added context behind the motivations behind the question explained in the question video.

### **Video Platform and Video Size**

For the final version of the survey we used YouTube to embed the videos into Qualtrics. YouTube makes it easy to upload videos and allows control over video quality, enabling full screen, play/pause, and replay. However, for some participants they would see recommended videos after watching the video in the survey, but not all users did. This is distracting and potentially confusing. The play button is also in the center of the video which blocks the signer. We included specific freeze frames so that it represented the overall message of the video, but because the play button was there [participants were unable to see this. YouTube also includes the title of the video at the top of the video, which leads to more English being there. This

defeats the purpose of having the ASL videos. To work around this we used the “.” character to name the video so it was not noticeable. The question videos were labeled as “Q1,” “Q2,” etc. where the number indicated the number of the question they were answering.

Video size is also another consideration to take into account. Some users commented that the videos were too small and it was hard to see them. Part of this was also that users had to zoom out on their browser window in order for the matrix to show up, so for some their window may have been smaller than they are used to. There was the option to make the videos full screen, however this is more disruptive and takes more clicks on the user’s part.

### **Recording Videos**

During the think alouds some of the participants commented on the recordings of the videos. They noted that the signer had good grammar and was very clear. A neutral background was used so as to not be distracting, and so the signer could be clearly seen. It is also important to be conscious of background, lighting, and attire. If the background is too busy or there is poor lighting it is difficult to see what the person is signing.

### **Translation Challenges**

The initial survey questions were done in English, however for the recordings they needed to be translated to ASL. Not all words directly translate to ASL so this led to some challenges. Signs were discussed and carefully chosen as we needed to consider if it was a regional sign for example, and needed to make sure it accurately portrayed what we wanted to communicate.

### **Adapting Think Aloud Studies to be ASL-centric**

The way a think aloud is typically conducted in English had to be adapted to be ASL-centric. We had to consider that rather than speaking, participants would be signing in ASL, and thus could not talk while performing a task on the computer. Participants were instructed to watch the videos first, then sign what they were thinking. We also had to consider how to get the participant’s attention during the study if they stopped signing. To get their attention they need to be looking at the Zoom window and the researcher’s video. Visual indicators must be used to get their attention, rather than auditory cues as in a think aloud conducted in English.

## **7.0 Conclusion**

The goal of this project was to determine the challenges and requirements for ASL-centric questionnaires. Matrix and hotspot questions were not intuitive and presented challenges. Considerations in the future regarding the video platform used should be taken into account and potentially the use of features such as hovering over videos should be tested. It is also recommended to be conscious of the number of videos used for each question, as it can take a long time for users to go through them all which was a point of frustration.

This study also identified challenges with developing ASL-centric questionnaires, such as translation and signer considerations, video platforms, and survey tools available. Different video platforms should be looked into as well as other survey platforms. It may be beneficial to develop a specific survey platform for ASL-centric questionnaires that is more suited for videos.

## **Acknowledgements**

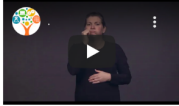






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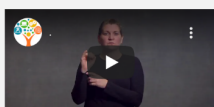
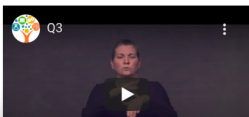
The ASL Ed Center is comprised of a core team of linguists, educators, technical staff, and educational resource developers, working with an expansive network of collaborators in the U.S. and other countries. Since 2005, members of their team have engaged in the study and development of American Sign Language-based tools for informal and formal education, assessment, and research with deaf participants. Their efforts and collaborations are synergistic; results and learning are consistently shared across products, projects, and among our partners. The current work of AEC builds on previous efforts to develop ASL-centric learning experiences and materials, create and share STEM learning materials in ASL online, and design curricula that fully engage the minds of deaf and hard of hearing students.

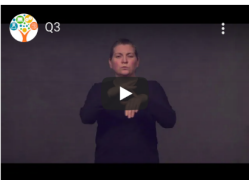





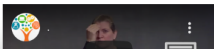
# Appendices

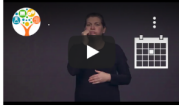


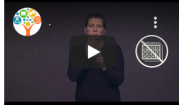



## Appendix A: Final Survey Design





The image shows a screenshot of a video player interface. At the top left, there is the WPI logo (Western Piedmont University) and the text "WPI". Below the logo, there are two video thumbnails labeled "Q1" and "Q2". The "Q1" thumbnail shows a person in a dark suit gesturing with their hands. The "Q2" thumbnail shows a person in a dark suit holding a green object. Below these, there is a larger video player area containing a "Q2" thumbnail on the left and a horizontal row of four smaller "Q2" thumbnails in the center. Below the horizontal row, there are two rows of four small red circles, each aligned with one of the thumbnails above it. The interface has a dark blue border on the left and right sides. In the top right corner of the player area, it says "100%".









				
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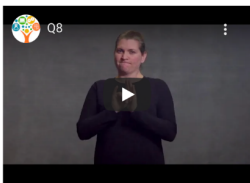
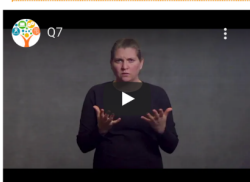
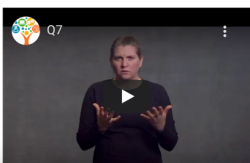
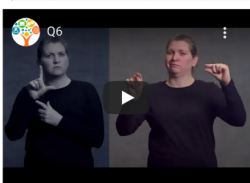
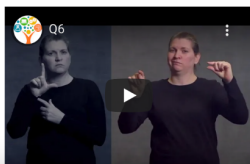
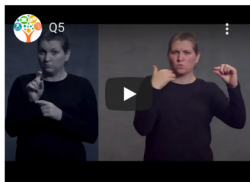
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Q8

Q9

English ?

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