

USING A DIGITAL APPLICATION TO REFRESH KNOWLEDGE OF  
ABUSE FOR INDIVIDUALS WITH INTELLECTUAL/DEVELOPMENTAL  
DISABILITIES  
BY  
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## ABSTRACT

Individuals with Intellectual/Developmental Disabilities (I/DD) are abused more frequently than individuals without disabilities. One potential reason for this discrepancy, is the low rate at which instances of abuse are reported by those with I/DD. It has been shown that learning about abuse and how to report it, can cause an individual with I/DD to feel more confident about reporting any future instances of abuse. Within this work a digitized version of the current in-person abuse prevention training program, called the Awareness and Action (A&A) training, is developed and evaluated. The hope is that providing an application capable of refreshing an individual's knowledge of abuse could help individuals with I/DD maintain their confidence in reporting abuse over the long term.

The resulting application is designed with the help of several individuals with I/DD through a collaborative design session. Engaging members of the community provided a variety of valuable insights that impacted the usability evaluations.

Usability evaluations were conducted remotely with six participants with I/DD. Of these six participants, five had been or were currently A&A trainers.

Through the use of collaborative design and usability evaluations, this work demonstrates that an application may indeed be an effective way of reinforcing knowledge of abuse. All participants in the usability evaluation indicated they would download and use the application; and that they would recommend others do the same.

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## CHAPTER 1

### Introduction

In the US, 9/10 individuals with Intellectual/Developmental Disabilities (IDD) will experience at least one instance of abuse<sup>1</sup> in their lifetime; of those abused individuals, half will be abused ten or more times [2]. Moreover, individuals with I/DD are generally at a higher risk of violence, such as assault or other violent crimes, than individuals without disabilities [3]. Yet, incidents of abuse against individuals with I/DD remains severely under reported. For example, **only 3% of sexual abuse cases involving persons with I/DD are ever reported**[2].

Researchers have found that individuals with I/DD are most often abused by those they already know, such as a caregiver or a family member [4]. Abused individuals may have nearly *every* part of their life monitored by the person abusing them. Perpetrators of abuse use their connection to, or control of, the abused to manipulate them into remaining quiet; whilst larger societal attitudes tend to discount the voices and experiences of people with I/DD. It is this manipulation and the general perception that they will not be taken seriously that pose the largest barriers for getting individuals with I/DD to report abuse [4].

#### 1.1 Problem Statement

Empowering individuals with I/DD to report incidents of abuse must be a top priority for society. It has been found that undergoing abuse prevention training can improve the understanding, recognition, and reporting of abusive behavior [4]. Today, the *Awareness and Action* (A&A) program provides such trainings in Mas-

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<sup>1</sup>Within this work abuse is defined as “*an act or omission which results in serious physical or emotional injury to a disabled person*” [1].

sachusetts for anyone who is able to attend. These three-hour training events take participants through multiple types of abuse, warning signs, and how to properly report instances of abuse.

The importance of the material contained in the A&A training cannot be understated; yet physical trainings do suffer from some distinct drawbacks. Logistically, individuals with I/DD who wish to attend a training must coordinate travel to the physical location in order to participate. Moreover, trainers themselves can only host so many sessions a year, potentially leaving certain populations without access to trainings for extended periods of time. Unfortunately, if these types of logistical barriers are not overcome, it can be hard to maintain an understanding of the material, as frequency has been shown to be crucial for individuals with I/DD to maintain knowledge [5, 6].

Even when users have unfettered access to as many trainings as they need, motivating them to attend may be difficult. Motivating an individual to complete any action can be a challenge, let alone when a user finds a task to be boring [7]. Some individuals may view the idea of completing additional refresher courses on abuse as a boring prospect, since there will be no new information presented. One can assume that compounding this boredom with the logistical challenges mentioned above may lead to difficulties when it comes to motivating individuals with I/DD to complete enough trainings to maintain their knowledge about abuse and how to report it.

Not only can attending trainings be challenging due to logistical and motivational issues, but emotional issues may emerge as well. Unfortunately, individuals with I/DD who attend the training may have experienced the types of abuse being presented, these images may trigger emotional responses in the participants. During the in-person training, when individuals become emotionally triggered by the

content of the training, staff members are there to step in to alleviate the mental distress. One must not forget that the individuals attending the training may have been abused themselves or may *still be involved in an abusive situation*.

## 1.2 Proposed Solution

One potential solution to the aforementioned logistical problems of attending multiple training sessions could be to digitize the in-person A&A training, thus making it accessible anytime and anywhere. Special care would have to be taken while creating the application to ensure that users are motivated to use it regularly, whilst simultaneously preventing users from becoming triggered by any of the materials. This work intends, through the use of collaborative design (co-design) and usability evaluations to determine if such an application *could* be developed. If successful, this application could enable individuals with I/DD to better protect themselves and those around them.

Motivating a user to return to an educational application regularly can be challenging. Applications are always seeking new ways to generate either intrinsic or extrinsic motivation to increase user retention. Since external forms of competition have been shown to cause anxiety that can reduce learning performance [8], using intrinsic motivation to encourage persons with I/DD to complete refresher trainings regularly may be preferred to extrinsic motivation. One promising way to foster intrinsic motivation in educational contexts is to apply elements from *gamification*, such as awarding points or providing a narrative that users progress through.

Whilst focusing on developing an engaging application that will motivate users to keep coming back is important, one cannot forget that the material in the A&A training may be challenging for individuals to work through. There will be users who have been abused, users who have witnessed abuse, and users who may have

lost friends or family to abuse. Throughout the in-person training, instructors ask participants to join them in a number of calming breathing exercises and grounding activities, such as a sensory exercise in which participants are asked to describe small objects using all of their senses. Likewise, a digital version of the training could also provide similar activities to prevent users from experiencing undue emotional distress, along with providing simple mechanisms to connect with emergency contacts.

This work explores what types of grounding activities may be well-suited for consumption in a digital format in both the co-design and usability studies. Within the later study, a digital xylophone is used as the grounding activity, wherein participants may play musical notes until they feel calm enough to continue with the lesson. Extreme caution must be taken with this portion of the application, as emotionally triggering an individual who may not have anyone in their proximity can be a traumatic experience. If an individual is using a digital application on their own, in the comfort of their home, and they become triggered, the potential outcomes can be quite negative.

Creating an effective application, one capable of refreshing all of the knowledge presented during the A&A training session, will require trial and error. Through the use of co-design and usability evaluations, this work will explore a wide variety of formats to present the learning materials in. In the end, the hope is that an effective format to convey the A&A training can be found.

To assess the viability of a digital version of the A&A training program, several key research questions were identified:

1. What aspects of interactive content inspired by ideas of gamification work for the refresher application?
2. How are grounding activities built into the application received by the audi-

ence?

3. Can an application effectively refresh an individual's knowledge from the Awareness and Action training?

### 1.3 Findings

Overall, results from this work are extremely promising. Participants stated that they would download and use the final prototypes, that they would encourage others to do the same, and that the application was effective overall. Moreover, results from both included studies help in forming a set of recommendations for future applications that may prove to be effective at a large scale in refreshing an individual knowledge about abuse and how to report it. Interestingly, participants also uncovered novel use cases for the final prototypes that were not intended, a result expanded upon in Chapter 5.

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## CHAPTER 2

### Related Works

Developing an application capable of refreshing an individual's knowledge of abuse and how to report it is not a trivial task. Compressing the existing abuse education program entitled Awareness and Action (A&A) training into a digital format poses a number of unique challenges. One must take great care in not triggering any user of the final application, as the subject matter can be quite challenging, especially for those who have been abused. Then, one must ensure the application is engaging, that it provides enough intrinsic motivation to encourage users to continue using the application to maintain their knowledge in the long-term. Finally, one must provide materials and interfaces that can effectively be used to maintain the understandings gained at the in-person training session autonomously, so that individuals can practice as much as they see fit, without needing interventions from their friends/family/caregivers.

Literature included in this section addresses two main areas of research. The first section investigates previous efforts in digital learning for individuals with I/DD, while the second focuses on the application of various elements from gamification to educational contexts.

#### 2.1 Digital Learning for Individuals with I/DD

The introduction Massive Open Online Courses (MOOCs) have undoubtedly made learning more accessible than at any time in the past, however, are these types of courses **accessible** to individuals with I/DD? This is the question Guimarães and Mattos set out to answer in their work "Exploring the Use of Massive Open Online Courses for Teaching Students with Intellectual Disabilities" [1]. In their study, the researchers worked in collaboration with a Brazilian

Non-Governmental Organization for people with I/DD to provide a MOOC to complement vocational training designed to help the students obtain and maintain paid employment. To accomplish this, the program focuses on teaching early math operations and reading time on analog clocks. Five people from the program participated in this qualitative study, one instructor and four students with I/DD.

Before the technological intervention was introduced, each student had participated in roughly sixteen hours of in-person training with the same instructor. For the study, all students were brought to the same classroom they had completed their previous training sessions in, each was given a tablet, the instructor then provided a brief introduction to the devices and how to use them. A camera was used to record the entirety of the session. Once all participants were familiar with the devices, the instructor provided a fifteen-minute review of the topics the students were going to be covering during the session using the concrete-pictorial-abstract approach with physical materials, stating that the initial development of a concrete understanding better enables students with I/DD. Finally, the instructor walked the group of students through opening the MOOC application, Khan Academy in this case, and starting the required lessons.

During their time with the application the students were allowed to ask questions. After completing the lessons each student participated in an individual interview with two researchers, which lasted for 5-15 minutes. Researchers then analyzed the recordings of the session and the interviews to develop their results.

Overall, the researchers conclude that the participants in the study considered the experience to be a **positive** one. Their key observations were that tablets **did not** represent a barrier for the students, the instructor should be able to create their own lessons, students became dependent on hints quite easily, **positive feedback was a good motivator**, and that classroom coordination is a challenge when

using self-paced learning. To mitigate the negative observations the researchers uncovered, they suggest allowing instructors to design courses specific to their students, that all support should be provided in such a way that **encourages autonomy**, and that the introduction of self-paced learning into a classroom be studied further.

Although Guimarães and Mattos introduce the students to Khan Academy and discuss the need to develop autonomy within the students, they stop short of examining whether or not students would consider using Khan Academy on their own to continue their learning outside of the classroom. If the intention of MOOCs is to allow an individual to learn *anytime* and *anywhere*, the researchers should have asked if the students if they would be comfortable using Khan Academy on their own. Moreover, the application of the research done for this work to the current study is also limited by the content in question. Teaching basic skills is not emotionally equivalent to teaching individuals about a potentially triggering subject like abuse.

Identifying barriers for individuals with I/DD who want to **learn autonomously** is of the utmost importance, especially as technology continues to entrench itself into education. Buehler et. al identify problematic technical areas for persons with I/DD through the use of emic ethnography in their work “Accessibility Barriers to Online Education for Young Adults with Intellectual Disabilities” [2]. After years of observing individuals with I/DD interact with educational systems, the researchers consolidated their observations around the following categories: information retrieval, navigation and information architecture, file management, and password management. Buehler et. al explore how these problematic areas effect how individuals with I/DD perform a variety of technological tasks relating to education and propose mitigation strategies which

may help creators make more inclusive educational applications.

The researchers involved with this study collected their findings over *several years* helping administer an inclusive post-secondary certificate program designed to teach individuals with I/DD the necessary skills to promote independent living and employment. Specific accounts included in the work were collected over a semester with twelve students, six of which were persons with I/DD, the others were undergraduates. Each researcher in the study maintained a detailed set of field notes, identifying recurring issues and obstacles faced by the students with I/DD. Of particular interest to the current study is the recommendations laid out by the researchers within their work.

Recommendations from Buehler et. al include education and training for both students with I/DD and developers, using metaphors/visual cues/consistency in design, and including personalized predictions. Educating both students with I/DD and developers is a daunting task. Researchers recommend that students with I/DD receive specialized training on technical skills, something which is not always achievable, and frequent practice, which may be somewhat dependent on first having the skills. Additionally, they recommend that developers provide how-to videos to guide users through the various interfaces and functions of an application, while also suggesting that developers should be knowledgeable on guidelines for accessible design.

*Consistency in design* may be able to subvert some of the need for individuals with I/DD to receive specialized training, as consistent iconography could allow easier knowledge transfer between applications. Likewise, personalized predictions could help surface key information, preventing users from needing to *dig* for functionality. Moreover, Buehler et. al recommend that future research and development focus on improving visibility of interfaces, detecting and reducing

Concept	Description	Affected Behavior
Acknowledgement	Feedback that praises a players' actions (badges, medals, etc.)	Engagement
Competition	Player v Player, scoreboards, healthy conflict	Engagement / Motivation
Cooperation	Teamwork or co-op missions	Motivation
Imposed Choice	Decisions the player is obligated to make for the game to advance	Engagement / Motivation
Level	Hierarchical layers present in a game with allow a player to obtain new advantages	Engagement / Motivation
Novelty	New or updated information is presented	Engagement / Motivation
Objectives	Guide the players actions, short or long term	Engagement / Motivation
Point	Measurement of performance	Engagement
Progression	Allows players to locate themselves within a game	Engagement
Sensation	Use of senses to create new experiences	Engagement
Social Pressure	Pressure through interactions with other players (real or NPC)	Engagement / Motivation
Stats	Visible information related to the outcome of the game	Engagement
Time Pressure	Pressure through time within the game (countdown)	Engagement / Motivation

Table 1: The taxonomy of game elements considered for this work.

frustrations, and adhering to participatory design practices.

Unfortunately, the researchers in this study **fail to consider more than just the technical limitations** users may face in using online educational systems. Emotionally triggering material may pose real barriers to individuals with I/DD learning about sensitive subject matters, and issue entirely forgone by this work. *If a user becomes emotionally triggered, would that impact learning?* What barriers might exist when only teaching sensitive content, such as abuse?

## 2.2 Gamification

The Oxford dictionary defines gamification as “*the application of typical elements of game playing (e.g., point scoring, competition with others, rules of play) to other areas of activity, typically as an online marketing technique to encourage engagement with a product or service)*”. Within this work, elements of game playing are defined based on “A Taxonomy of Game Elements for Gamification in Educational Contexts” by A. M. Toda et al. [3]. A full table of game elements considered for this study are described in Table 1. Recently, gamification has been applied to educational context, yielding a wealth of information on building **intrinsic** motivation within users to learn.

Basic skills, such as counting money or recognizing numbers, are often taken for granted in able-bodied individuals, yet for those with I/DD, *mastery of these skills can be challenging to attain*. Unfortunately, lacking these skills can leave individuals with I/DD more dependent on others to carry out their daily activities. Morales-Villaverde et al. present the development and evaluation of a collection of games designed to allow users to practice basic skills in their work “Online Learning System to Help People with Developmental Disabilities Reinforce Basic Skills” [4]. Working with Imagine! and Hope Services, two organizations dedicated to providing care for individuals with I/DD, researchers iteratively developed and evaluated seven activities designed to help users recognize and work with numbers, colors, shapes, letters, and U.S currency.

Focus groups with an undisclosed number of participants were used to generate the initial requirements for the application. Requirements included the **use of acknowledgement via positive reinforcers** when a task was completed, clear objectives at the beginning of each activity, keeping the user informed of their progression throughout the application, an invisible time pressure via a ninety-

second countdown which would move the user forward if they had not interacted with the app, the use of *simple* elements, and the *avoidance of unnecessary content* on every screen. Once the entire set of requirements had been defined, prototypes were created, and preliminary evaluations conducted. Heuristic evaluations were completed using Nielsen's 10 Usability Heuristics, then a small cohort of individuals with I/DD along with their caregivers or guardians provided initial feedback on the application. These preliminary evaluations yielded a number of small bugs to fix and enhancements to make. Performance issues, such as timings, transitions, and user input issues were addressed; while enhancements like enlarging the buttons were developed.

Finally, a more comprehensive evaluation was conducted with ten clients of Hope Services. All participants were between the ages of 23 and 36 (mean = 28.4), there were four males and six females, all of which had I/DD. Participants were asked to try each activity on three different sessions over the course of two weeks, concluding each session with a short survey to assess their feelings towards the activity. Along with the survey, videos of all sessions were recorded and analyzed by researchers to look for positive/negative reactions, whether or not users needed assistance, and moments which required multiple presses to make a selection. Data from the coded videos and conducted surveys were then combined and analyzed, yielding the following results.

On average, *91.4% of users' reactions were positive* during the final evaluation. Averaging across all sessions and activities, 8.7/10 participants rated the activity they had just completed as fun, 9/10 rated it as helpful, 9/10 reported liking the activity, and 9/10 indicated they would use the activity again. Overall, the results of this study were **very positive**, though some users did require assistance from researchers on multiple occasions (52 times across the entire evaluation process).

Several conclusions can be drawn from these results. First, activities like the ones used here can be well received by individuals with I/DD. Second, individuals with I/DD *want* to use applications like the one proposed by Morales-Villaverde et al. And finally, completing activities like the ones found in this study *may* be helpful to individuals with I/DD.

While the results of this study are quite promising, there are inherent limitations to the work. Even though users responded favorably to the application both in their surveys and in their reactions, longitudinal research is necessary to know if these types of activities are truly effective ways to learn these basic skills for individuals with I/DD. Additionally, the skills covered by this work are concrete in nature, though this was the purpose of the study, it limits the direct application of the techniques presented here to more abstract concepts.

Studies like the aforementioned work by Morales-Villaverde et al. mention their requirements when designing applications for individuals with I/DD, yet they stop short of presenting frameworks for future efforts to build on. Shaban and Pearson aim to address this lack of a formal framework in their article “A Learning Design Framework to Support Children with Learning Disabilities Incorporating Gamification Techniques” [5], where they lay out both what to do and what to *avoid* when applying gamification techniques to educational contexts. Specifically, this work connects existing concepts from Human Computer Interaction (HCI) and cognitive load theories to suggest practices that bear in mind the *potential* limitations in working memory capacity that can be found in persons with I/DD. By drawing these conclusions, the authors offer a blueprint for applications that may better serve end-users with I/DD.

To construct their framework Shaban and Pearson conducted a survey and distillation of previous academic works in Cognitive Load Theory, multimedia learning

design, Human Computer Interaction concepts, impacts of I/DD on learning, and the *correlation between anxiety and lower academic performance*. Overall, their framework consists of four major components: analysis, design, development, and evaluation. Analysis involves understanding the end-users, their expectations, their needs, and their prior experiences. Shaban and Pearson offer many helpful guidelines for the design phase, all of which they organize into the following distinct principles: place the user in control, provide feedback, motivate the user to accomplish the task successfully, offer content in multiple modalities, guide users through activities, segment content, signal what is important, provide coherence through the entire application. Each principle, in turn, contains a number of guidelines to adhere to.

To place the user in control of their experience, Shaban and Pearson recommend providing *simple* and *intuitive* navigation, allowing the user to determine when, and for how long, they will use the learning tool, bolstering their sense of autonomy. Feedback should be provided throughout the experience in a positive and affirmative tone, even when incorrect answers have been supplied. Authors propose using a helper/guider in order to foster a sense of motivation to complete each task successfully, this helper/guider is also recommended for use when guiding users through activities.

Due to the wide variety of disabilities that can be found in the community of individuals with I/DD, any content in the application should provide **spoken and visual activities, rather than just written ones**. Segmenting content requires presenting activities in discrete units with clear objectives and rewards. Signaling what is important involves highlighting the most important elements and using cues sparingly during activities, minimizing the cognitive load from unnecessary elements. Coherence dictates that all activities in the application should work

towards the overall goals and that the application provide a concise report on the user's achievement at the end of each activity.

Along with the full set of principles and guidelines to adhere to, Shaban and Pearson also make it a point that future developers **avoid competition**, which may cause an *unnecessary* amount of anxiety and thus *decrease* intrinsic motivation. Furthermore, they stress the importance of simplicity in design, as *any element on screen places a burden on working memory*, which may be limited in individuals with I/DD - everything should serve a purpose. After developing an application using these principles and guidelines, Shaban and Pearson recommend evaluation via usability, user experience, and cognitive load tests. The final application should be easy to use, functional, and enjoyable for the end-users.

While these principles and their guidelines are thorough and represent a positive step towards designing successful applications for individuals with I/DD, there are certain elements which demand further investigation. Although the authors point out the potential shortcomings in the use of competition, they still recommend consideration of points as rewards for completing activities, one must question whether or not the use of points at all is conducive to a competition-free environment; points provide an instant mechanism for comparison to others, for boasting, and for being made to feel inferior. Furthermore, the authors made no effort to empirically test this framework, nor do they consider the application of this framework on the larger population of all individuals with I/DD, who all share in the same potential limitations in working memory capacity. Finally, their evaluation includes various different usability and cognitive load tests, yet they make no mention of using co-design to help foster the creation of an app designed for the end-user by the end-user.

Gamification is a **powerful** technique, capable of *drastically* impacting human

behavior. While there are a myriad of elements to consider when designing an educational system, there are some which appear to be more suited to the task than others. Generally, elements should be avoided if they require a large cognitive load, are distracting, or if they induce anxiety. Researchers should be encouraged to use simple mechanisms, especially acknowledgement in the form of binary rewards, to help motivate students.

### 2.3 Summary

Educating individuals with I/DD on sensitive topics using digital learning tools presents a number of challenges. Potential technical and emotional barriers must be accounted for. Applications must be accessible, intuitive, and they must motivate users to come back to reinforce what they have learned.

Researchers have gone to great lengths to detail potential technical limitations that can impact accessibility. Preceding works have demonstrated that existing systems, ones designed to teach benign materials, are reviewed favorably by individuals with I/DD; and, that gamification may be an extremely effective tool to drive positive user experiences. Yet, it remains unknown whether emotionally triggering materials can be taught using similar mechanisms.

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## CHAPTER 3

### Study I: Collaborative design for selection of important elements

This qualitative study explored what gamification elements, *if any*, should be included in an application designed to reinforce materials learned at the Awareness and Action (A&A) training program. Selection of key elements for testing began with a survey of preceding efforts in educating persons with Intellectual/Developmental Disabilities (I/DD) and concluded with a collaborative design (co-design) session to evaluate a set of medium-fidelity prototypes. In order to create the necessary prototypes to complete this work, **personas** [1] were generated to embody *potential* end-users of the application. Multiple **scenarios** [2] were then created around each of the individual personas, acting as *narratives* which were then distilled into discrete **use-cases** [2]. Finally, these use-cases were used to generate a formal set of **Volere atomic requirements** [2].

After constructing a set of requirements, an initial set of low-fidelity prototypes were created using Adobe InVision, a drag-and-drop prototyping tool. Low-fidelity prototypes were iterated on several times within the research group; work at this stage in the project revolved around getting the prototype to more closely align with the stated formal requirements. Previous works in co-design, particularly those works including individuals with I/DD, have shown that having functional prototypes, also known as *concrete probes*, can facilitate more productive sessions [3]. Unfortunately, Adobe InVision lacked several crucial features at the time of this study that prevented the low-fidelity prototypes from being used as concrete probes. Once the low-fidelity prototypes had gained a consensus amongst the researchers behind this work, they were re-created as medium-fidelity prototypes with HTML/JavaScript, providing the necessary functionality to act as

concrete probes during the co-design session.

The co-design session was then held, using the medium-fidelity prototypes to demonstrate the functionality of each prototype. Feedback from this session was collected and analyzed to guide the effort of creating the high-fidelity prototypes used in the following study. Over the next several sections the key steps in this study are outlined, results are presented, and conclusions discussed.

### 3.1 Generating Interactive Prototypes to Act as Concrete Probes

As mentioned above, generating interactive prototypes to act as concrete probes was viewed as crucial to the success of the co-design session. After establishing a set of initial requirements, prototypes were iterated on until they were deemed appropriate by the entirety of the research group involved at this stage.

#### 3.1.1 Requirements Gathering

The first step taken in the development of the initial set of requirements was the creation of several personas [1]. Personas embody those who are intended to use the final application, *fictional* characters described in vivid and realistic detail, they provide an *anchor* to make decisions from at every stage in the development cycle by allowing creators to continuously ask the question: *can persona x use feature y to accomplish goal z* [2]. Moreover, extra care must be taken when designing for individuals with I/DD due to the wide variety of assistive technologies which must be accounted for. Creating personas with I/DD can help ensure every feature is built in an accessible manner from the beginning.

For this study three distinct personas were created: Alex, Dave, and Jessica. Each persona was given a profile page within the project documentation consisting of a fictional biography, an image, goals, motivations, frustrations, impairments, the technology they use, and whether not they need assistance to use their tech-

nology. After finalizing the personas profiles, each was given a set of scenarios, or “informal narrative descriptions” [4], focusing on **how** a task gets done in the application, rather than **what** gets done. These stories provide a more natural way to consider the needs of the user, their overarching goals, and how they feel whilst using the application to complete their task [2]. Several scenarios were written for each persona of various lengths and complexities.

Each of these scenarios helped expose implicit assumptions and expectations, refine the personas themselves, and guide the creation of more formal use-cases for the application. Use-cases capture direct interactions between a user and the application by focusing on functional requirements [2]. In this work, use-cases were created following the **essential use-case** framework, a framework that focuses on discrete steps that alternate between *user intentions* and *system responsibilities* [5]. Thinking about the application in terms of system responsibilities as direct responses to user intentions helped discussions remain productive and focused.

For this work, each individual scenario was broken into as many use-cases as necessary to express all functions required to complete the scenario. Finally, these use cases were then used to generate the formal requirements of the project. An individual requirement defines an *expectation* for what the application will do or *how* it will perform [2]. For this work, the **Volere atomic requirement** [2] framework was selected to create requirements.

In the Volere framework, each requirement has a general type, links to the relevant use cases in the project documentation, a brief description, rationale, the originator or author of the requirement, fit criterion, customer satisfaction/dissatisfaction ratings, the priority, any conflicting requirements, supporting materials, and the history of changes made to the requirement. In total there were twelve initial requirements drafted during this phase. Although the process

of design *should* be iterative [2], these twelve requirements formed the foundation for the creation of the prototypes which would be used in the collaborative design session.

### 3.1.2 Developing the Prototypes

Preparing the prototypes for the collaborative design session was a challenge, as they needed to be functional enough to convey the idea, but not so complete that participants take anything for granted. Towards this goal, each prototype began as a low-fidelity mock-up created using Adobe InVision, a drag-and-drop prototyping software, allowing the research team to iterate quickly without having to re-write any actual code. These prototypes were considered internally within the research group and iterated on so that they better reflected the needs of the three personas. After working through a number of versions of each prototype within InVision, each prototype was *recreated* as a medium-fidelity prototype, using HTML and JavaScript, which provided additional functionality not available within InVision.

For this work, **five different prototypes** were generated from the list of formal requirements. Each prototype focused on a *different* key element identified during the requirements gathering process. Key elements considered at this stage were: emotional reinforcement, grounding activities, skills games, interactivity, and quizzes. Each of these individual elements, along with their corresponding prototypes are discussed in detail in the following sections.

## Emotional Reinforcement

Emotional reinforcement was proposed as a mechanism to provide *intrinsic* motivation to end-users. Within this prototype, users are given a virtual pet, as seen in Figure 1. Whenever a user *completes a lesson*, their pet would become **happier**; however, this happiness would also *decay over time*, encouraging users

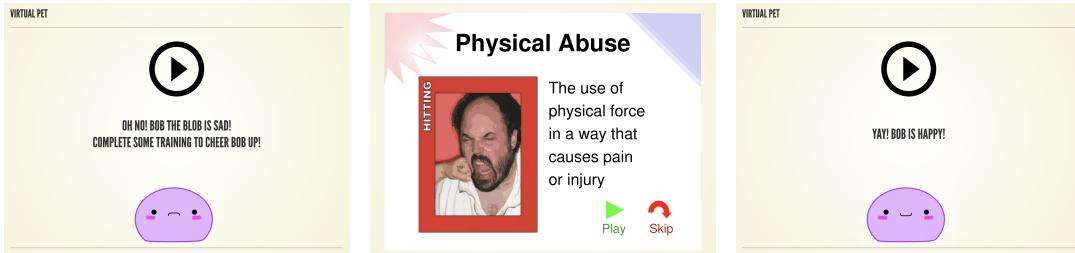


Figure 1: Screenshots from the medium-fidelity prototype focusing on emotional reinforcement. In the first image one can see the pet is sad, after completing a lesson, the pet becomes happier.

to complete lessons frequently enough to *keep* their pet happy. Applying emotional reinforcement in this way was designed to reward the users of the application for completing lessons whilst preventing the emergence of *extrinsic competition*; since this technique removes the notion of points or cumulative rewards, *user-to-user rankings would be impossible to create*.

## Grounding Activities

Grounding activities were proposed as a way to help keep users from becoming *emotionally triggered* as they moved throughout the applications’ lessons. The material presented in the application is of an emotionally charged nature, especially considering some users may have experienced abuse first-hand. A large number of ideas were considered viable grounding activities, examples include breathing exercises, small games (such as solitaire), or simple math activities. Although InVision was not suited for creating interactive elements, a box-tapping game was built in HTML for the medium-fidelity prototype, some screen shots of this game can be seen in Figure 2.

## Interactive Elements

The prototype focusing on interactive elements explored whether or not a *more interactive* interface could help *increase engagement* with the materials. In order



Figure 2: An example of a grounding activity where users are asked to tap all of the boxes to clear the screen.



Figure 3: Screenshots of the Interactive Elements prototype focusing on video content and continuous interaction.

to answer this question, this prototype featured a video with several buttons that allowed the user to constantly interact with the application. As the video (sourced from the existing A&A training) played, users would be asked to mark things they thought were/were not abusive. As seen in Figure 3, the interface proposed in this version of the prototype relied on two major buttons, signaling abuse or no abuse, similar to the flagging exercise used in the A&A training, where participants are asked to use two physical flags to signal abuse/no abuse as the video plays.

After the video finished playing, users would be brought into an educational flow depending on their reactions to the video, an example of this flow can be seen in Figure 4. If a user successfully marked the abusive segments of the video as containing abuse, the user would be asked to identify the type of abuse, and then the lesson would conclude. However, if a user *did not* successfully flag the abusive behaviors, a series of questions would follow the video to teach the user about



Figure 4: Examples of corrective actions taken after the conclusion of the video if the user did not successfully identify the abusive behavior.



Figure 5: A series of questions from the Quizzes prototype.

the abusive behavior they witnessed in the video. Unfortunately, the required mechanisms to demonstrate this educational flow to the participants of the co-design session could not be completed in time, thus the flow had to be demonstrated by manually flipping through various screens.

## Quizzes

Quizzes were considered an *integral* part of this application from the inception of the project. Prompting users to answer a series of questions was viewed as a crucial step to developing a deeper understanding of the content. The prototype focusing on quizzes attempted to evaluate the value of an application that provided *only* quizzes. In Figure 5, a set of example questions from this prototype are shown.

## Skills Activities

Instead of focusing entirely on the material itself, this particular prototype was proposed as a way to help users refine **tangential skills**. During the collab-

orative design session, participants were presented three distinct games, focusing on emotion identification, private body parts, and counting money. In Figure 6, a screenshot of each activity can be seen.

Within the emotion identification activity, users would be asked to select the emotion that the person in the image was expressing. The hope for this game was that enhancing somebody's ability to detect and identify various emotions would help them better recognize warning signs of abuse.

In order to help individuals better recognize sexual abuse, No Touch Zones, an activity centered around identifying no-touch zones on the body was presented. Within this activity, users would be asked to identify the no-touch zones on two drawings of a male and a female by selecting them on their screen. These drawings can be seen in Figure 6.

Finally, focusing on financial abuse, an activity centered around counting money was presented. The Counting Money activity would require users to select US currency denominations until they had reached a pre-specified amount.

These various activities were put forward to see if participants in the collaborative design session believed developing these soft skills could help individuals with I/DD recognize abuse more rapidly, without actually showing emotionally triggering content.

### **3.2 Results from the collaborative-design session**

To evaluate and refine the medium-fidelity prototype for the final evaluation, the co-design session was held with a group of individuals who work closely with the existing A&A training. Overall, six co-designers attended this meeting, denoted C1 through C6; of the six participants, C1, C2, C3, and C4 were individuals with I/DD, C5 and C6 were able-bodied individuals. C1, C2, C3, and C4 were self-

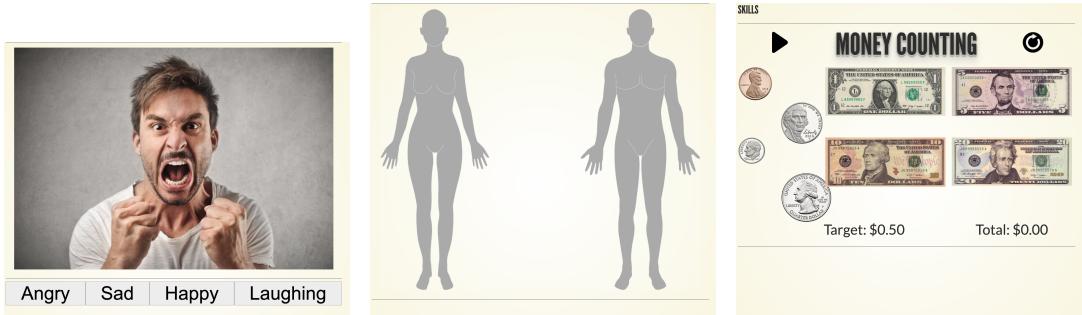


Figure 6: Screenshots from the Skills Activities prototype. From the left to the right, the activities presented are Emotion Identification, No-Touch Zones, and Counting Money.

advocates<sup>1</sup>; while C5 and C6 were coordinators who worked with self-advocates. For the session, the medium-fidelity prototypes were both projected onto a large main screen and printed so that they could be distributed to all participants within a physical binder. Throughout the session participants were asked to vocalize as much as possible, to ask questions freely, and to draw in their binders if they desired. Not only did several researchers take notes during the session, but it was also recorded in its entirety.

During the session, the digital prototypes were treated as concrete probes [3], participants were free to request the researcher to click anywhere they wanted so that they could experience interaction with the application. The principal researcher of this study led the group through each of the aforementioned prototypes, with a series of interview questions being posed after each had been shown in its entirety.

### 3.2.1 Emotional Reinforcement

Overall, participants viewed this prototype negatively. Participants unanimously agreed with C5’s sentiment that “[the application should] never take any-

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<sup>1</sup>A self-advocate is an individual who speaks up for themselves and their own interests. It is used to describe individuals involved in mutual aid networks for individuals with I/DD.

*thing away from somebody*”, with C5 offering the following suggestion as an alternative: “*if you were able to have different items that they could access as they level up, they never get taken away from them, but if they want to become, I don’t know, a master at something, they’re working their way up to that*”. When reflecting on this guidance, it becomes apparent that the emotional reinforcement mechanism does not fit this bill. Instead of monotonically progressing, the emotional reinforcement prototype had provided a pet that would lose happiness if the user had not logged in and completed a lesson for a certain amount of time. This insight from the participants of the co-design session was directly acted upon for the next iteration of the prototype.

### 3.2.2 Grounding Activities

Unlike the element of emotional reinforcement, grounding activities were both less contentious and viewed overall positively; all participants agreed that they should remain in the application. At various points within the current A&A training, the instructors take the participants through grounding activities, such as breathing exercises, in order to keep all of the participants relaxed even though they are learning about emotionally charging content. Just like the in-person training, the application also contains potentially triggering materials, and should endeavor to keep users calm. Participants unanimously agreed with C1’s sentiment that “*it can be a little hard for people [to go through the training]*”, along with C2’s feeling that grounding activities would “*keep more people engaged*”. When asked about what type activities should be included, C4 said “*some people are more apt to do the grounding games than sit there and say like okay my app is telling me to breathe, I am breathing, you know?*”, with C5 adding “*everyone regulates differently*”.

The next option proposed during the co-design session was to allow the user

to select their own grounding activities from a short list of three or four options. C5 quickly pointed out that “*I’m not confident that people know what regulates them*”, leading the group of co-designers to agree that having the application rotate through a variety would be best for the next round of evaluations.

New insights gained for this element included a time limit of approximately ten minutes, which would help users keep moving, along with the ability to skip the activity if the user did not need it, which generally aligned with earlier research in [6] - users have a desire to feel autonomous, *mandatory fun* can diminish a user’s feeling of autonomy. Participants also suggested various types of activities that should be considered, such as activities involving early mathematics, painting, etc.

### 3.2.3 Interactive Elements

Integrating video content into the application proved to be *challenging* during initial development due to technical limitations, as described in Section 3.1.2. Guidance from participants in the co-design session provided much needed clarity even though the prototype of this feature **was not fully implemented**. Unfortunately, the neither the low, nor the medium-fidelity, prototypes were capable of fully demonstrating the desired functionality. In the case of the former, InVision did not support playing videos at all; in the case of the latter, the research team lacked sufficient knowledge of JavaScript to fully implement the needed functionality for the session.

Instead, co-designers were shown the video while being informed of what users could do during the video, utilizing their abuse/no-abuse buttons to signal about what they were watching. Unlike the in-person training, the application relied on complicated logic to control what the user saw after the video finished playing. Behind the scenes, each video would be split into a discrete number of shorter clips which would be designated as containing abuse or not containing abuse. As

the video played, if a participant failed to signal a clip which contained abuse as having abuse, the system would record this event, after the conclusion of the video, the system would ask the user if they had actually seen abuse or not, to ensure that they had not simply forgotten to signal during the abusive scene, if the user correctly answered this question they would be advanced in the lesson, if they did not, they would be taken to slides about the type of abuse contained in the clip to foster a deeper understanding.

Overall, participants believed integrating videos would be beneficial, but that the process was too complicated. C4 joked “*Can you see the smoke coming out of my ears yet?*”. Furthermore, co-designers agreed that, instead of playing the entire clip and then asking questions, that the application should, as C4 put it: “*stop the video, ask a question, then go on*”, alluding to the notion that discrete clips with intermittent prompts would be easier for the target audience of the application. This element in particular demonstrates that even when a feature is not fully-functional, participants with I/DD were more than capable of both understanding the *intentions of the element* and *providing key feedback*.

### 3.2.4 Quizzes

Quizzes were universally agreed upon, in a similar manner to the concept of grounding activities, all participants believed that having quizzes would benefit the application. However, the original idea proposed was vetoed by the participants. In the medium-fidelity prototype, the quiz acted as a standalone lesson, without preamble. When asked if having just the quiz on its own would be a good thing, all of the participants agreed with C4 that it would ‘probably not’ be good. Instead, C4 recommended that “[it] should either, you know, talk about physical abuse or show the video” before asking any questions. Participants also agreed with C5 that the quiz should “be an option for anyone who chooses to take it”, to avoid giving

certain users *anxiety* about using the application.

### 3.2.5 Skills Games

The final element considered in this co-design session was the use of skills games to approach the problem of understanding and identifying abusive behaviors from a novel direction. Three skills games were presented: *Identifying Emotions*, *No Touch Zones*, and *Money Counting*, as described in Section 3.1.2.

Identifying Emotions presented users with images of human actors expressing various emotions, users were asked to identify the emotion being expressed. We found that this game was rejected quite quickly, with participants feeling emotionally charged by simply looking at a male actor expressing anger, one participant was **visibly disturbed by the images** - we considered this skills activity to be *too dangerous* to continue with. Unlike Identifying Emotions, the other two games were favorably reviewed.

No Touch Zones asked users to select the no-touch zones on two human bodies, one male and one female, which were rendered as basic line drawings. All participants thought this skill was important and that the game format was adequate, though some small suggestions were made, such as how the application should provide some form of positive reinforcement when a correct area was touched.

Money Counting asked users to add up denominations of US currency to reach a specified total, in the hopes that this skill would help users catch acts of financial abuse. Again, all participants believed this skill would be useful, no suggestions were made for this game.

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## CHAPTER 4

### Study II: Usability evaluations of high-fidelity prototypes

This qualitative study explored whether a mobile application could effectively reinforce material learned at the Awareness and Action (A&A) training program. After concluding the collaborative design (co-design) study discussed in Chapter 3, feedback from co-designers was integrated with the medium-fidelity prototypes to create three high-fidelity prototypes, written in Dart/Flutter. These high-fidelity prototypes were fully functional, slightly stylized, and mobile-friendly.

Evaluations were conducted with six individuals with I/DD, focused on soliciting feedback on a variety of issues, including: the usability of the application, its effectiveness, and participants willingness to download/use the application. Along with explicit verbal feedback prompted by a series of interview questions, video recordings were made of all sessions and analyzed for non-verbal reactions, such as laughter or incorrect selections. Results from the evaluations were analyzed to set the stage for future works in this area. Over the next several sections the key steps to this study will be broken down and elaborated on.

#### 4.1 Usability Study Methods

##### 4.1.1 Setting

The setting for the user evaluations in this study was a video conference call hosted on the Zoom videoconferencing platform. Due to the Covid-19 pandemic, the organization and execution of in-person trials was considered too dangerous to attempt, as they could have potentially jeopardized the health of participants and researchers alike. In accordance with previous research on remote user evaluations in [1] and [2], remote-synchronous trials were implemented, facilitated by Zoom.

Participant ID	Age	Gender	Disability
P1	34	M	ASD
P2	46	F	IDD - Hearing Loss
P3	29	M	Seizure Disorder, ASD
P4	43	M	Acquired Brain Injury - IDD
P5	27	F	William Syndrome, PTSD, Chronic Anxiety
P6	N/P	M	N/P

Table 2: Table of participants for the usability evaluation.

#### 4.1.2 Participants

There were six participants recruited for this evaluation. All six participants had some degree of Intellectual/Developmental-Disabilities (I/DD), three were actively conducting A&A trainings, two had been A&A trainers in the past, and the final participant had never been an A&A trainer. Participants were between 27 and 46 years old, all of them were technologically savvy and able to communicate verbally due to the nature of the remote evaluation. See Table 2 for details on each participant in this study.

#### 4.1.3 Materials

Each participant received, as materials, a link to their individual virtual meeting. Participants used their own devices to sign in to the meeting. Since we could not distribute devices containing the application to each individual and monitor their usage, the primary researcher in this study made use of the **screen share** feature in Zoom to share an emulator running the application with the participant. If a user logged into the meeting on a computer, control would be ceded to them, again via the help of Zoom; if a participant logged in on a mobile device that was not capable of taking control of the shared emulator, the participant would be asked to *direct* the principal researcher to click through the application for them. When the principal researcher was required to maintain control of the emulator, they acted solely as the ‘hands’ of the participant, allowing them to dictate *without*

*correcting them.*

#### **4.1.4 Measurement Instruments**

To measure the success of the application a number of different data-collection methods were implemented. Participants in the user evaluations were asked to provide as much verbal feedback as possible whilst using the application, along with answering pre-determined interview questions at various intervals. This entire process was recorded and transcribed for thematic analysis, which combined participants' responses to the interview questions with their observed behaviors during the trial. While the *primary* conclusions presented in this work emanate from the participants answers to the interview questions, the thematic analysis performed on the entirety of the evaluation provided additional insights into user sentiment.

#### **4.1.5 Procedure**

User evaluations were completed with one participant per session over the course of two weeks. Each session lasted approximately one hour. Participants initiated the session by signing into the Zoom conference call via a provided link at a pre-determined time.

Once a participant joined the meeting, a researcher verbally walked them through the informed consent form which they had already signed and submitted to verify their intent to participate in the study. After confirming that the participant understood the nature of the research, the principal researcher attempted to give control to them via Zoom's 'remote control' feature. As mentioned in Section 4.1.3, this feature only worked when a participant joined the call on a computer, otherwise the participant was asked to dictate what they wished the principal researcher to click on.

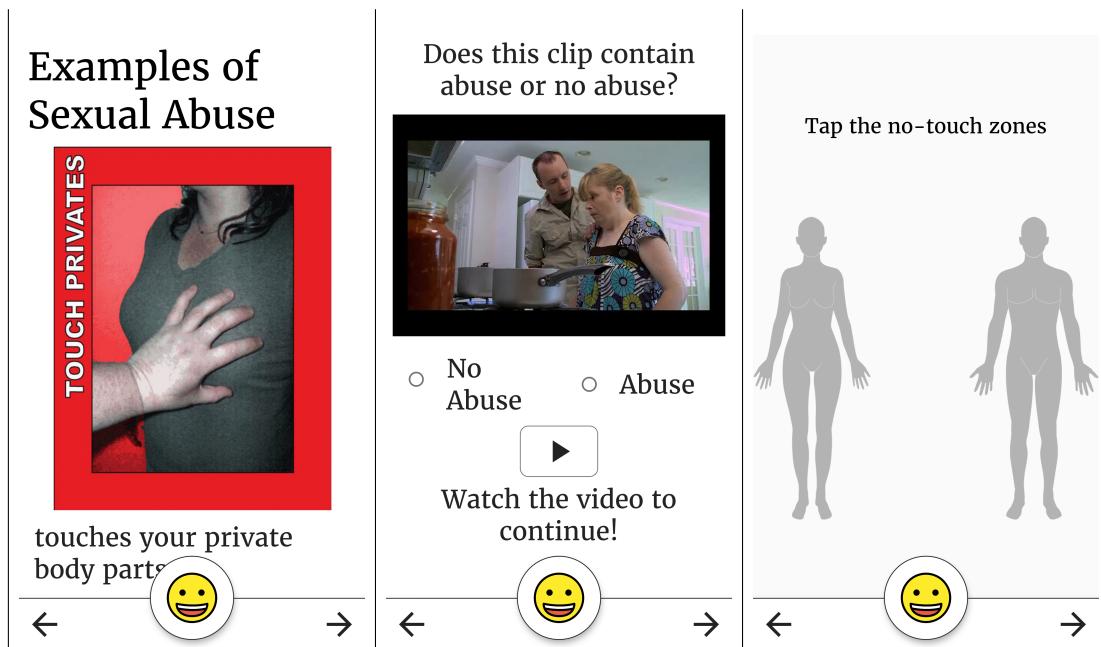


Figure 7: Examples from all three versions of the final prototype. *Left*: A slide from version A. *Center*: The video screen from version B. *Right*: The No-Touch skills game from version C.

During each session three distinct prototypes were trialed. Each version attempted to refresh the participant’s knowledge of **sexual abuse** in a *different* way. *Version A* used a deck of slides which were extracted from the A&A training materials. *Version B* presented the updated version of the video content from Section 3.1.2; based on feedback from the co-design session, the sexual abuse video from the A&A training was segmented into three discrete clips, two of which contained abuse. Finally, *version C* trialed the *No Touch Zones* skills-game as discussed in Section 3.1.2. A screenshot from each of these versions can be seen in Figure 7.

While the order each participant viewed each version was counter-balanced, the general flow of each session was as follows:

1. Instructions were given, including the directive to vocalize as much as possible during the study

2. The user is given an orientation of the application by the lead researcher
3. Control transfer is attempted
4. The user was asked to complete a version of the lesson
5. Survey questions were asked on the version they had just completed
6. The same two steps above were repeated for each version
7. After all versions had been viewed, questions on all three versions were asked

Once the above steps had been completed participants were debriefed and they signed off, concluding the evaluation.

#### **4.1.6 Data Analysis**

The collected recordings from the evaluations were transcribed and analyzed for thematic content with regards to user sentiment towards each version. A code for this analysis was developed over several iterations of thematic analysis. Particular emphasis is placed on participants' answers to direct questions, *supplemented* with their reactions while using the application and the number of interventions needed for them to complete a lesson. Quotations were then selected from the evaluations to illustrate the sentiment of each participant.

The code developed during this process is reflected in Table 3.

## **4.2 Results**

User evaluations yielded a wealth of knowledge with regards to the efficacy of an application designed to refresh an individual's knowledge about abuse. Both the interactive portion and the follow-up questions were designed to be semi-structured, allowing participants to communicate however they saw fit, moreover, participants were *guaranteed anonymity* to encourage an honest and open discussion. Overall, there were 337 total themes identified. Of these 337 themes, 201

Theme	Definition	Examples
Positive Reaction	When a participant exhibits a positive reaction while using or discussing the application.	"This is good", "I like this", "Wow"
Negative Reaction	When a participant exhibits a negative reaction while using or discussing the application.	"This is bad", "This is confusing", "I don't agree", "I don't understand"
Intervention Required	When a researcher has to intervene so that the participant can complete a task.	"I need help", "How do I?"
Incorrect Response	When a participant selects an incorrect answer.	"Oops"
Enhancements	When a participant suggests an improvement to the application that is not a fix.	"Add feature X"
A&A Connection	When a participant connects the application to the in-person training.	"This reminds me of x from A&A"

Table 3: Definition of the code used for the thematic analysis.

were positive, 68 were negative, with the rest distributed between intervention, suggestion, awareness, and incorrect. All of the themes recorded during the analysis process loosely fit into five distinct areas, each of which is broken down and expanded upon in the following sections.

#### 4.2.1 The Impact of Interactive Content on Engagement

Within this work, three prototypes were evaluated which can be broadly classified as having either static or interactive content. In version A users are presented with a deck of slides, a static medium, which fared poorly overall. Version B and C contained videos and skills games respectively, two interactive forms of content which solicited user input during the entirety of the lesson. It is clear that based on the overall rankings from each participant, depicted in Table 4, interactive content was preferred to static, with 6/6 participants preferring either version B or C over

Participant	Favorite	Middle	Least Favorite
P1	B	C	A
P2	C	A	B
P3	B	C	A
P4	C	B	A
P5	C	B	A
P6	B	A	C

Table 4: A table displaying participants' favorite version of the prototype. Overall versions B and C tied as participants' favorite.

version A.

### Video Quizzes were Engaging

Between version B and C, participants generally seemed to indicate that they did have a preference for the videos in version B, with thirty positive reactions towards that modality versus twenty for the skills game found in version C. P1 put it quite explicitly, commenting during his trial with version B, that he “*Definitely like[s] this version better because it plays the video clips. ... Because you get to see it action*” . Even though P4 and P5 preferred the skills game in the end, they both shared some key insights as to why the videos were so effective. P4 stated with regards to the video “*they'll understand it better that way than if you're just showing pictures... how do we know what it means if we don't have the video in it?*”, while when P5 compared slides to the video he had this to say: “[*The slides*] *don't give you an example of reality, but when you put in videos, now you have a reality.*”

### Skills Activities were Informative

Although version C did have fewer positive remarks, it still tied with version B for the participants' favorite. While some of this may be caused by the negative reactions to the user interface in version B lowering its overall appeal, which will be discussed in the next chapter, it demonstrates that skills games may be an

effective tool for learning. P2 found that the skills game was “*very useful, I think people would understand it*” and that “*they would learn more with the body parts*”. Likewise, P5 found that “*The skills game make[s] it easier to identify what is.*”

### Lack of Engagement with Slides

During the course of the user evaluations, participants expressed a number of concerns, critiques, and issues with version A. P5 stated “*I think if you just have slides, then the slides just run together*”, a sentiment shared by others during the evaluation.

### Navigation was Intuitive

Access to technology can be limited for persons with I/DD if applications are not designed with them in mind, ease-of-use is of the utmost importance. All six participants reported that the application was easy to use, with most participants giving concrete affirmations that they thought the system was intuitive. P1 stated that “*I don't think anyone would be confused. ... I think everyone would get it.*”, P2 said “*it was very easy for me to use it*”, sentiments shared by the other participants.

### Acknowledgment was Effective for Motivating Users

Integrating the element of acknowledgement into the application was considered crucial to motivate users to return to the application. The use of emojis to acknowledge when a user completed a lesson was enjoyed by **all six participants**. P6 in particular seemed to greatly enjoy the experience, after every lesson he completed, he took the time to change his emoji to the newly unlocked one. Moreover, no participant reacted negatively to that element in any of the presented prototypes.

#### **4.2.2 The Importance of Including Grounding Activities**

Preventing users from being triggered emotionally should be of the utmost importance while working with sensitive topics, such as abuse; especially in a digital setting where users may be alone. As P5 so aptly pointed out, when completing these types of lessons at home, if one were to be triggered “*Where is there to go? Where is there to feel safe if you’re technically supposed to already be in the safe spot?*”. Physical trainings do not suffer from this same issue, again as P5 pointed out, “*the good thing about the personal trainings we do is you can take a staff and go out into the hallway and cool down.*” These excerpts clearly demonstrate the seriousness of keeping individuals, who may be alone, grounded during the learning process.

Within this study, we explored the effectiveness of music as a grounding activity through the use of a *Xylophone* activity in which users were allowed to play various musical notes; a screenshot of this activity can be seen in Figure 8. One interesting observation was the participants enjoyment of the music activity as a grounding exercise. Overall, P2, P3, P4, P5, and P6 all expressed positive feelings towards the music application. When asked if it would help individuals relax, P3 confirmed that “[he] think[s] it would.” Moreover, several participants played with this activity at **every opportunity** during the evaluation.

#### **4.2.3 Using the Application for Reporting Abuse**

Although the application presented in this paper was designed for learning, several participants insisted that it could serve a larger role for the community of individuals with I/DD. P1, P2, and P4 all believed that the application could also be used to help individuals with I/DD **report abusive behavior**. Specifically, these participants believed that individuals with I/DD, especially those who are non-verbal, could use this application to express *what happened to them* to those



Figure 8: The Xylophone grounding activity.

around them. P2 stated that users could use the app to say “*this is what happened to me, and they can click on the picture and show the person. ... it's going to be very helpful to some people. I'm not saying everybody, but some people are going to get very good use out of it.*”, and that “*I think people are going to call DPPC more and use the hotline than what they're doing right now.*”, clear indications that this application may be an effective tool for reporting. P4 noted, while looking at the *always-available menu*, as seen in Figure 9, “*That's really a good way to ask the question, 'How can I help you?', well, I need to call this person, the DPPC, okay well click that.*”

While reporting abuse was not a goal for the application presented in this study, participants demonstrated the *need* for consideration in that direction. Instead of relying on verbal and gestural descriptions, providing users with a reference library of the different types of abuse could be empowering.

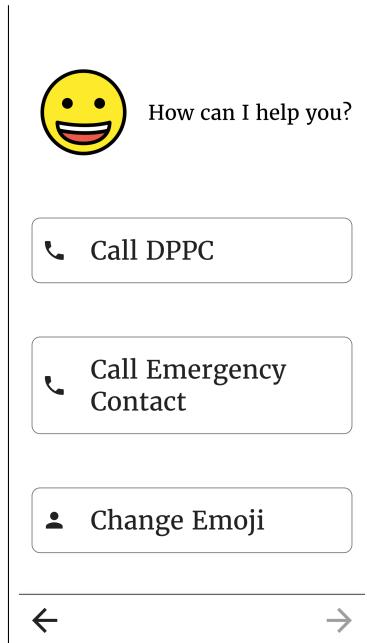


Figure 9: The always-available menu.

#### 4.2.4 The Effectiveness of Using an Application to Refresh Knowledge of Abuse

Participants in this evaluation were asked to use the prototype and answer follow-up questions. Both of these techniques indicated that users found the application to be an overall success. All six participants in this study indicated that they would download the application, that they would use the application, and that they would recommend others download and use the application as well. Overall, participants believed that this application would be effective at refreshing the knowledge attained during the in-person A&A training. Concrete examples of this belief can be found across all six evaluations and across all three of the presented prototypes.

#### Recommending Others Use the Application

Within this study, recommending that others download and use the application to refresh their memory is considered an indication that the participant

**believes the application to be an effective learning tool.** P1, as an A&A trainer, stated that he would recommend his students use the application “*every 48 hours, every two days*” after having seen all three versions of the application presented during the user evaluations. Similarly, P2, P3, and P6 also stated that others should use the app either daily or every other day so that, as P2 stated, “*they can remember what they saw, or if something happened to them, they can show it*”. Unlike P1, P2, P3, and P6; P4 and P5 provided looser guidance as to how often users should complete lessons. P4 indicated that, in regard to the training, “*if you do it less, then you’re not gaining the strength to tell somebody, if you use it more then you’re gonna be like okay, now I know I really need to say something. Cause’ a lot of people just shut down, they get shocked, they don’t know what to say, they don’t know what to do, and I think that if it was more that it would definitely be a better thing to have.*” Somewhat contrarily to all of the other participants, P5 strongly emphasized that users should only use it “*As they’re comfortable.*” focusing on the fact that individuals have undergone different amounts of trauma and that they know best what is good for them.

### **Willingness to Download**

Additionally, all six participants declared that they themselves would download the application, although P1 stipulated that he would only do so “*if it was like version B*” (the video-based version). Interestingly, all participants stated that they would use the application less than or equal to the number of times they would recommend others use it. P5, when asked if he would download and use the app explained it as follows “*I would download it. Because I don’t know how often I would use it, but I would definitely download it. But, then again, I’m a trainer and trainers only look over it once every while.*”, a sentiment that may have been felt across participants 1 through 5, all of which were either actively conducting

A&A trainings or had done so in the past. P6, the only person who had not been an A&A trainer, was also quite confident in his understanding of the material, explaining “*I don’t need to do like the daily one I don’t think.*”, belying a sense of confidence which may warrant further investigation.

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## CHAPTER 5

### Discussion

Individuals with I/DD are abused at a higher rate than able-bodied individuals [1]. One potential way to reduce the rate of abuse is to educate individuals with I/DD about abuse, what to do when it happens, and how to report it; hopefully preventing further incidents from occurring. The purpose of this work was to create a digital application capable of refreshing an individual's knowledge of abuse *anytime and anywhere*.

Based on the results of the usability study, one can conclude that the prototypes presented in this work may be a viable way to refresh an individual's knowledge of abuse based on the Awareness and Action (A&A) training. All participants indicated that they thought the application would be beneficial, that they would recommend others use it, and that it would be effective. From the literature review conducted in Chapter 2, it can be seen that research into educational applications for serious contexts, such as abuse, with individuals with I/DD is under-explored. Consequently, based on the results from this work, recommendations are outlined for future works in this area.

#### 5.1 Recommendations for Future Applications

Even though participants in Chapter 4 stated that they would download and use the application as it was presented in the usability study, based on the results of both studies conducted in this work, it appears a combination of prototypes may be more effective than any of the prototypes on their own. Overall, results from Chapter 4 demonstrate that participants found Version A (Slides) to be boring, that Version B (Video) was challenging to use, and that Version C (Skills Activities) may not have had enough content. Meanwhile, results from Chapter 3 indicate

that slides can play a crucial role in providing context for the more dynamic units, such as the video quiz or skills activities.

Therefore, while none of the prototypes were found to be perfect individually, a combination of the three versions is promising. More specifically, the results in this work indicate that arranging content as: slides, followed by a grounding activity, followed by a video-quiz or skills activity, finally followed by an acknowledgement, could be *highly* effective. Hybridizing the prototypes in this way could take advantage of the strongest aspects of each, while simultaneously mitigating their shortcomings.

## 5.2 Solutions for Reporting Abuse for Individuals with I/DD

One of the key points uncovered during the usability evaluations was the importance of providing mechanisms to facilitate the reporting of abuse for individuals with I/DD who may or may not be non-verbal. Several participants mentioned this need at various points in the evaluations. Focus should be directed towards providing interfaces that individuals with I/DD can use to quickly navigate through large quantities of content, allowing them to quickly surface images of importance so that they can show others a specific image at a moment's notice.

One illustrative example would be, imagine a user who wishes to show a mandated reporter what happened to them. This user should be able to open the application, navigate to an image depicting what happened to them, and show that image to the reporter, quickly and easily. Providing users with a way to communicate about and better report abuse could prove to be an effective mechanism for stopping additional instances of abuse in the future.

### **5.3 Limitations**

Although user evaluations conducted in this study yielded positive results, there were a number of potentially limiting factors. Time constraints, made worse by the Covid-19 pandemic, forced the scope of this work to narrow, leaving key elements for further investigation. While this work has flushed out the necessary components, it did not examine the correct composition of components, nor stylistic decisions, so that the application could be intuitive to use for individuals with I/DD. Furthermore, these studies themselves were conducted with only a single individual who had not previously taught the A&A training, potentially biasing the results in the positive direction, as our participants were all individuals who already believed in the efficacy of the training.

#### **5.3.1 Accessibility was not a Focus of Research**

Although participant responses were positive to the interview questions, during the user evaluations, the number of interventions required for a participant to complete a lesson were tracked and recorded. Of the thirty interventions required for all participants to complete the three lessons, nineteen of them were for the video unit, with seven for the quiz, and the remaining three divided equally between the music, skills, and navigation. Along with the interventions, a few participants did express their feelings about the video interface during their experience with the prototype, with P2 stating “*this whole section confused me*”. One should note the contradictory findings from the answers to the questions versus the number of interventions required to complete the unit.

Overall, focusing more on accessibility and the intuitiveness of the application could help reduce the number of interventions, allowing participants to experience more of the application for themselves rather than requiring assistance to complete activities. Future work should focus on improving the design of the application

to decrease the number of interventions necessary for an individual to complete a lesson.

### 5.3.2 Sample Population Biases

Participants in Chapter 4 were predominately A&A instructors at one point or were actively providing A&A trainings at the time of the evaluations. Recruiting from this population for these evaluations may have biased results in the positive direction, as these participants have a direct interest in the A&A training materials. Moreover, these participants may be generally biased to applications more similar to the A&A training, especially if they believe the current training to be effective.

### 5.3.3 Limitations in User Device Control

For this study, users were asked to log in using the device of their choosing. Unfortunately, this prevented the ceding of control to any participant who did not join the session from a desktop computer. The inability for certain participants to control the application due to technical limitations may have biased results as dictation can hide certain misunderstandings. For example, when a participant dictated something like ‘next’, the researcher controlling the emulator would take that to mean clicking on the arrow to move the screen forward, even when other interpretations were possible, such as scrolling.

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## CHAPTER 6

### Conclusions and Future Work

This thesis pushes forward the scientific communities' understanding of what an effective application for refreshing an individual's knowledge of abuse may look like. After conducting an initial survey of previous efforts in teaching individuals with Intellectual/Developmental Disabilities (I/DD), two studies were conducted sequentially in which persons with I/DD were asked to help design and help evaluate several prototypes. Findings from these studies formed the basis of application recommendations that will hopefully prove effective in future larger-scale research efforts. Hopefully, continuing to improve the accessibility of educational tools for persons with I/DD can help improve the rate of reporting abusive behavior and, in turn, reduce instances of abuse.

Study one in this work used collaborative design (co-design) to evaluate the potential effectiveness of five different prototypes. Within this work participants were shown a concrete probe and asked to provide as much feedback as possible. Even though certain elements in this stage were difficult to explain, numerous valuable insights were provided, from ruling out elements that would not work, to improving elements that would make it to the usability study.

Study two, the usability evaluation, focused on determining the most effective way to engage with potential end-users of the final application. Executing this study in a remote synchronous fashion proved to have several challenges, yet the information obtained was nonetheless informative and insightful. Watching several participants manipulate the application directly revealed points of friction in the user interface, with semi-structured interview questions providing deeper insights into how participants felt while using the application. Overall, results from this

study were extremely promising.

Several conclusions can be made based on the results of the two studies included in this work. First and foremost, it is clear from the evidence gathered during the execution of this work that an application can be an effective tool to refresh an individual's knowledge about abuse. Individuals explicitly stated that they would use the application *as it was presented*, a high-fidelity prototype, immediately; and, that they would recommend others do the same. These results were even more promising as the participants making these claims were, in some cases, themselves A&A trainers.

Second, one can conclude that remote synchronous evaluations are a viable way to overcome challenges present in the current global climate. During the trials presented here we experienced only minor technological glitches and managed to glean a depth of information.

Finally, one can see a clear indication that individuals with I/DD need an application like the one proposed here. Not only do the results indicate that the application could be effective in refreshing knowledge, they indicate that an application like the one proposed here could also increase reporting directly through the use of the included buttons designed to call an emergency contact or the DPPC, along with the imagery which could be used to communicate precisely what happened to the user themselves.

## 6.1 Recommendations for Future Research

Future research should focus on accessibility of the application through the use of a large-scale remote asynchronous study, with periodic interviews to assess the successful integration of the application into lives of the participants. Extending this work with such a study could provide the last step in taking the proposed application to being production ready. Within this work, it is recommended that

researchers present a singular version of the prototype, a combination of the three versions presented in Chapter 4, as discussed in Chapter 5. In order to better understand the results from this study, the final application should be properly instrumented to emit metrics for the research group to analyze; metrics such as the frequency of use, number of incorrect responses, number of navigational movements during a lesson, and the time spent on each page could provide valuable insight into the intuitiveness of the application.

Along with this larger-scale study, an effort should also be made to understand how this application could better serve in the roll of assisting individuals to report abusive behavior. Within this work, a more formative approach should be taken, perhaps beginning with a focus group or a co-design session focusing on how to lower the barriers to reporting so that individuals with I/DD may feel confident in their ability to report abuse successfully and securely. Special attention should be given to the indication that users of the application may benefit from having a library of imagery accessible for when they are trying to communicate what has happened to them. Moreover, future work could consider the implications of providing a way to report abuse in which individuals are able to actually reports about abusive events using the pictures from the application directly.

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