

Board 207: Breaking Digital Barriers: Designing a Sociotechnical System for Remote Digital Assistance

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Illuminated Devices: Designing a Sociotechnical System for Remote Digital Assistance

Abstract The Building Adult Skills in Computing program at Michigan Technological University helps address the digital literacy needs of older adults in the Houghton area. The program pairs university students with adults in need of technical assistance to provide personalized technology tutoring at the Portage Lake District Library. Despite its success, the program faces limitations in reaching older adults beyond its local community. An expansion is proposed, introducing the Illuminated System: a sociotechnical framework integrating digital technology and human interaction. The system employs Illuminated Devices which, when distributed through trusted locations, enable remote access to tutoring. The Illuminated System aims to reach learners anywhere, connecting learners directly to tutors through digital devices while maintaining the feeling of community-based in-person tutoring.

1 Introduction

Although the term “Digital Divide” was coined some 25 years ago, most steps to address this problem have focused on inequalities in physical infrastructure or financial barriers. A Pew study found that 34% of older Internet users have “little to no confidence in their ability to use electronic devices to perform online tasks” and 73% of older adults cannot set up new devices without assistance. Mentoring and training for those with less digital experience can help to resolve these problems, but is often restricted to specific geographical areas, such as our outreach program BASIC. We want to design a system that can bring quality human tutoring to digital learners regardless of their physical location.

Since 2011, our group has run an outreach program that pairs technologically savvy students at our institution with community members seeking help in navigating computing technology. Wider-scope problem solving strategies, more transferable between tasks, are emphasized in our program. Strategies allow users to explore (understand the full space of affordances available to them) and tinker (understand how their actions affect the system state) in a safe, methodical way. Exploration and tinkering are enabled by a set of certain attitudes on the user’s part, including confidence, creativity, attentiveness, and perseverance. Together these strategies and attitudes provide a foundation for lifelong, independent learning. Social Cognitive Theory provides guiding principles for our community program: Tutors model problem solving and exploration, work with learners to articulate goals, and put the learner in the driver’s seat as much as possible to build self-efficacy.

Using a design-based methodology, we are developing a sociotechnical framework that blends

digital technology and human interaction, providing digital technology instruction. We want to: (1) Reach learners whenever they need help, (2) Connect learners to tutors directly through common digital devices, and (3) Make the personal, interactive nature of a community-based tutoring program available anywhere.

Contact with human tutors is invaluable in helping individuals overcome obstacles, build skills, and gain confidence in the use of digital technology. Public libraries and other institutions can provide shared physical spaces to facilitate this kind of learning, but there are limitations: learners may have difficulty accessing these spaces, and the technology issues they face may be inextricably situated in their homes, offices, or other locations. The Illuminated Devices project seeks to complement in-person tutoring with online assistance that meets learners where they live and work. Each Illuminated Device is an iPad with a custom portal application that facilitates communication with a human tutor, providing a broad view of user activity across hardware and software applications, and conveying tutor input to learners in a way that minimizes distraction and maximizes flow. The Illuminated system allows tutors to record learner progress and to confer with one another on technical issues. The poster provides an overview of our design and implementation and includes a system walkthrough.

In this poster, we outline an expansion to the BASIC program that allows us to reach patrons outside the Houghton area. This expansion would also allow us to reach patrons inside the Houghton area who may not have been able to visit the library where BASIC sessions are held in person.

2 Development

Our team employed a Design-Based Research (DBR) approach to developing the Illuminated System, following an iterative and human-centered design process. DBR, commonly used for developing educational interventions, integrates theory and literature while incorporating continuous incremental changes to enhance scalability [1, 2].

The DBR process encompasses six key phases:

1. Focus: Determine the project audience and scope.
2. Understand: Study learners, the learning context, and existing solutions.
3. Define: Set concrete goals and assessment criteria
4. Conceive: Create an initial design for the solution
5. Build: Implement the solution (at increasing levels of fidelity)
6. Test: Evaluate the solution (at increasing levels of fidelity)

During the *focus phase*, a Design Thinking Workshop involving the research team and key stakeholders, including former BASIC tutors and librarians, determined the overall project audience and scope. The *understand phase* extended previous research findings [3, 4, 5, 6, 7] through meetings with staff at three community partner locations (which had previously hosted in-person tutoring sessions) and semi-structured interviews with 13 community members aged 40 to 90. These individuals owned or used at least one piece of computer technology (smart phone, computer, tablet,

etc.) and had sought help for their technology or expressed a future need for assistance. The interviews explored past and current technology challenges, concerns about using the prospective system (e.g., privacy, protecting personal information, breaking the device), and opinions about receiving tutoring through a tablet. The interviews also provided context for various usage scenarios, such as in the library or other community locations, at home, and while traveling.



Figure 1: Use scenarios.

communities and help distribute Illuminated Devices to learners in need. These locations may be places like libraries or retirement homes that are already frequently assisting older adults. Our lenders need an application to manage their devices and check their devices out to patrons who want to use them. It's essential that this application is as easy to understand and use as possible, so as not to create undue burden on our lenders using our system. The application must (1) allow lenders to access the devices assigned to them, (2) allow lenders to access a list of patrons, and (3) allow lenders to assign patrons to devices. This assignment of patron to device not only allows us to keep track of who has each Illuminated Device, but also serves as an important connection for allowing the patron to get personalized help when they contact a tutor using the device.

The tutors in the system are highly skilled with technology and are specially trained by BDB for assisting older adults with their technological needs. BDB already specially trains all tutors that

These findings informed the *define phase* in which a list of system features was developed and prioritized for each of the system components. The *conceive phase* began with the development of an Illuminated System process flow chart. Following a premortem with the full design team [8], the system requirements were revised and wireframes for each sub-system were developed in Balsamiq to guide implementation.

3 Design

The Illuminated System is comprised of a network of Illuminated Devices, highly skilled tutors, and trusted locations that all work together to help accomplish our goals and assist our patrons. Each aspect of the system has its own concerns that must be addressed in the design. Use cases for the Illuminated Device are depicted in Fig. 1.

The Illuminated Devices are systems with access to our Illuminated Portal web application, including iPads and desktop systems. The design of the portal is similar to Smart Life Solutions' CallGenie, No Isolation's Komp, and Amazon's Echo Show: minimalist, restricting the patrons' actions exclusively to starting a video connecting with a tutor. By keeping the interface as simple as possible, we keep the barrier to entry as low as possible allowing us to reach the most learners.

Our lenders are provided with a fleet of iPads that have the Illuminated Portal on them. The lenders are locations that we trust to serve their

communities and help distribute Illuminated Devices to learners in need. These locations may be places like libraries or retirement homes that are already frequently assisting older adults. Our lenders need an application to manage their devices and check their devices out to patrons who want to use them. It's essential that this application is as easy to understand and use as possible, so as not to create undue burden on our lenders using our system. The application must (1) allow lenders to access the devices assigned to them, (2) allow lenders to access a list of patrons, and (3) allow lenders to assign patrons to devices. This assignment of patron to device not only allows us to keep track of who has each Illuminated Device, but also serves as an important connection for allowing the patron to get personalized help when they contact a tutor using the device.

participate in BASIC, and tutors in the Illuminated System are expected to complete similar training. This training notably differs from BASIC training in that it will include other information about how the Illuminated System works as well as additional instruction for managing the differences between digital and in-person tutoring. Tutors need an application to connect to video calls with patrons. The tutor application must be able to accommodate the different functions that tutors have to perform, such as (1) connecting to a video call with calling patrons, (2) creating and maintaining notes about patrons and the tutoring sessions with patrons, and (3) chatting with other active tutors in case additional assistance is needed.

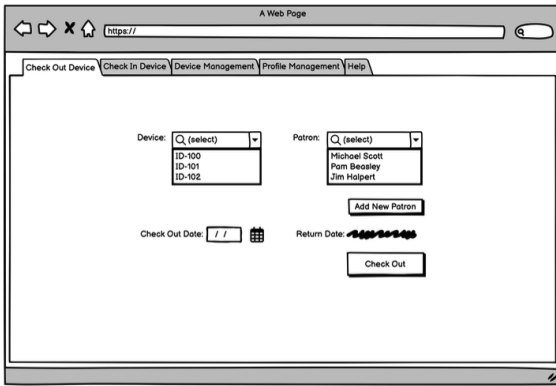


Figure 2: Organizations can check out devices to patrons

Lastly, we also consider the role of a single administrator whose job is to assign waiting patrons to available tutors. The administrator on duty is a tutor with the added responsibility of managing the patron queue, and typically does not directly engage with patrons unless all tutors are busy. Multiple tutors can be administrators, but only one tutor is acting as an administrator at any given time. For simplicity, we refer to the administrator as a separate role despite it simply being an additional responsibility of tutors. For these reasons, we assume that all administrator functionality must be built into the same application that non-administrator tutors use.

4 Implementation

All non-patron functionality is incorporated into a webbased application built with ReactJS. This consolidation means that tutors (including administrators) can access all required functionality from the same location, and that this functionality can be accessed from any device with Internet access. The locations that we select to distribute the Illuminated Devices also use the web app in order to check out devices to patrons. Patrons check out Illuminated Devices from designated locations, so they will still be using native iPad apps as they will never access the system from their own devices. Using native iPad apps for the patron front end allows us to simplify the process for them, such as by utilizing Guided Access to prevent them from accidentally navigating away from the app.

Patrons are able to check out Illuminated Devices from locations which can then be used to enter a video call with one of our trained tutors. Locations have unique logins to the web app that they use to check devices out to patrons. Each location account is managed by an organization account (organizations are the managers of their own accounts). Locations are able to add new patrons, modify patron details, and keep track of their organization's Illuminated Devices all from the same place. Organizations have all the functionality of locations, but are also able to manage their locations. Devices are registered to organizations, meaning all locations that belong to the same organization can check in or check out the same devices. Patrons are also linked to organizations, meaning that all locations under the same organization utilize the same patron list.

We opted to use the Zoom Video SDK for implementing video calling services in our system. This SDK is highly flexible, allowing us to use it both in the web-based app and the native iPad app without sacrificing feature parity. Patrons have a minimalist view, seeing only their own camera input, the connected tutor's camera, and the audio and video controls. Tutors have multiple tools in their views allowing them to control their respective meetings, see all currently open meetings, read Patron notes, and send messages to other tutors. The administrator view is identical, with the added functionality of being able to assign waiting patrons to available tutors.

To control the SDK, a client that connects to Zoom's API is initialized. This client creates meetings, and the meetings can be started by (1) creating a session name and username for each user, and (2) sending an encrypted payload to Zoom's API. The encrypted payload contains our SDK key, a user role, the session name, a token issue timestamp, and an expiration time. After sending this payload, a stream is initialized for each user. Each stream controls the audio and video controls that the users can interact with. Streams also find all audio input and output devices and video devices available for use and displays them, allowing the user to specify their preferred devices. The video of the patron and tutor are then embedded into an HTML canvas or video element, depending on browser compatibility, allowing communication to occur between them.



Figure 3: Administrators pair calling patrons to available tutors

Each meeting is logged in our database and consists of currently logged-in patrons and tutors and the meetings that are ongoing. Once a patron opens the app and indicates that they would like to connect to a tutor, they enter a queue where they can then be assigned to a tutor. Once a patron has been assigned to a tutor, they both are placed in a meeting with a custom meeting ID, the patron is removed from the queue, and the tutor is marked as being in a meeting. When the tutor is done with the meeting they are marked as available and are then able to be placed in a new meeting with another patron.

5 Illuminated System Walkthrough

Patrons seeking assistance from the Illuminated System start by visiting a location that has Illuminated Devices for check out, such as a library. The librarian (or other administrator) checks the device out to the patron by recording some information about them and linking them to the device via the website. Lending locations are responsible for choosing the return date and informing the patron of it, and their view is shown in Figure 2. After the device is checked out, patrons are free to take it anywhere that they need digital assistance—such as in their car or at home.

When a patron needs help, they turn on the Illuminated Device and are greeted by the Illuminated Portal. Patrons need only push one button and let the Illuminated System and our on-duty administrator knows that they need help. The administrator will see that there is a patron waiting in the

queue, and select an available tutor to assign them to, as shown in Figure 3. The tutor accepts the assignment, and a video call is initialized between patron and tutor.

Tutors are able to see the patron's video and any session notes that have been recorded about the patron in previous visits. This allows the tutor to get a quick history of issues that the patron has had and helps them assist the patron in the current moment. Tutors also have a back-channel chat that allows them to request assistance from other tutors, in case the patron has a question outside their area of expertise. The view that tutors see while in a call with patrons is shown in Figure 4. Patrons are free to express any concerns and questions they have to the skilled tutor and receive the help they need with setting up their router, making a new email account, or connecting their phone to a Bluetooth device.

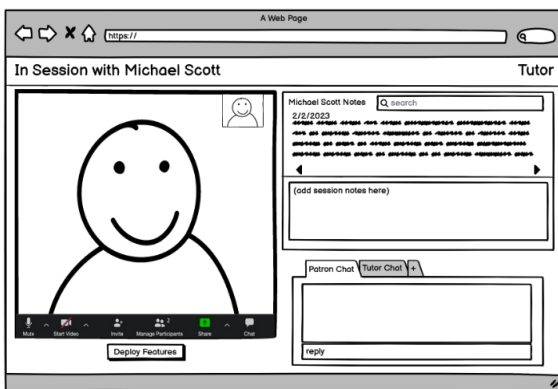


Figure 4: Tutors have notes and a chat displayed alongside the patron

involves standard usability testing approaches (e.g, think aloud protocols) and metrics to assess effectiveness, efficiency, satisfaction and subjective usability [9]. The “Build” phase of the DBR process is where we see iterations of sub-design processes in this project, as testing with humans reveals new errors and considerations which must be refocused and redesigned.

We are in the process of testing Illuminated Devices at two public libraries and a workforce development agency. As part of our assessment, we will not only focus on system usability [10], but also on the extent to which tutoring through the Illuminated System supports improvements in digital competency [11, 12] and self-efficacy [13] and reductions in tech-related anxiety [14].

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Admins are the people who have control over the patrons, tutors, and devices. Each admin can view and edit each piece of information relating to them, and they can add and remove them as needed by the locations providing Illuminated Devices. There is another type of admin, the Super Admin, who can manipulate information relating to the providers of Illuminated Devices, in addition to everything that regular admins do.

6 Future Work

Development is a continuous process of use, feedback, redesign, and implement. We continue to solicit user feedback and develop new designs as necessary. Usability assessment in-

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