Experiential Learning in Computing Accessibility Education

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ABSTRACT

Many developers don't understand how to, or recognize the need to develop accessible software. To address this, we have created five educational *Accessibility Learning Labs* (ALL) using an experiential learning structure. Each of these labs addresses a foundational concept in computing accessibility and both inform participants about foundational concepts in creating accessible software while also demonstrating the necessity of creating accessible software. The hosted labs provide a complete educational experience, containing materials such as lecture slides, activities, and quizzes.

We evaluated the labs in ten sections of a CS2 course at our university, with 276 students participating. Our primary findings include: I) The labs are an effective way to inform participants about foundational topics in creating accessible software II) The labs demonstrate the potential benefits of our proposed experiential learning format in motivating participants about the importance of creating accessible software III) The labs demonstrate that empathy material increases learning retention. Created labs and project materials are publicly available on the project website: http://all.rit.edu

CCS CONCEPTS

• **Human-centered computing** → *Accessibility*; • **Social and professional topics** → *CS1*; *Software engineering education.*

KEYWORDS

Accessibility Education, Computing Education, Computing Accessibility

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1 INTRODUCTION

Despite a significant portion of the world's population having a disability, much of the software being created today is unfortunately not being created in an accessible manner. To address this limitation, we have created five *Accessibility Learning Labs* (ALL), which utilize an experiential learning structure. The objective of these hosted labs is to to both inform and motivate participants about foundational concepts in developing accessible software. The following work describes the labs, along with an evaluation of the labs comprised of 276 students at RIT.

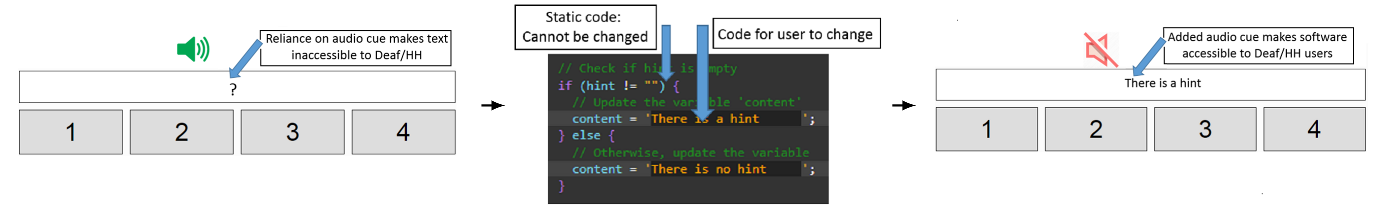
2 ACCESSIBILITY LEARNING LABS

A primary objective of our labs is to enable easy adoption in a variety of settings ranging from outreach events to conventional classroom activities. While primarily oriented and evaluated towards the undergraduate population, material can serve to positively impact other groups such as the 9-12 to graduate audiences. Adoption is supported by providing complete necessary instructional content and by enabling the labs to be utilized using only a browser, requiring nothing to be installed. Some of the provided components include background instructional material on the accessibility issue and 'empathy-creating supplementary material' which includes a YouTube hosted video of a student with the examined disability discussing how inaccessible software has adversely impacted them.

An example lab is represented in Figure 1, where this 'Deaf/Hard of Hearing' lab asks users to click on an image when a sound appears. With no visual cue, this software is inaccessible to users who are Deaf/Hard of Hearing (Figure 1a). Participants are then asked to perform a trivial task of selecting the image when notified, but this time no audio cue is played, thus reasonably simulating what a Deaf/Hard of Hearing user would experience. This makes the simple task of clicking on the image when notified quite challenging. Participants next add a visual cue to the activity and then use the application with sound notifications deactivated again (Figure 1b). This time however, due to the visual cue the task of selecting the proper icon should be much simpler (Figure 1c).

Each of the five labs addresses a different topic in computing accessibility education. The following topics are addressed:

(1) Deaf/Hard of Hearing
(2) Colorblindness
(3) Blindness
(4) Dexterity issues
(5) Cognitive impairments



(a) Software is inaccessible since user cannot hear the notification and the visual message is not relevant

(b) Mock IDE used through browser

(c) Software is made more accessible by student adding informative visual message.

Figure 1: Example of student repairing accessibility problem using simulated IDE

3 EVALUATION AND RESULTS

3.1 Experimental Design

To understand the effectiveness of our created labs and their design, we evaluated them in ten sections of an introductory Computer Science course at RIT which comprised of 276 students. Four of the sections utilized existing educational accessibility material, which served as our baseline (Group A). Three other sections used our lab, but *without* the supplementary empathy creating material (Group B), and the other three sections used our labs with the supplementary empathy creating material (Group C). To provide the necessary evaluation data, each of the three groups used the following steps to conduct the activity: I) Pre-lab-survey, II) Background material on the addressed concept, III) Conduct Activity, IV) Empathy-Building Supplementary Material (Group C only), V) Quiz, VI) Post-lab-survey.

3.2 Analysis Results

We then used the collected data to answer these research questions:

RQ1. *How effective are the labs in motivating students about the importance of accessibility?* We compared Group A (existing material) against Group B & Group C (created material). We used the pre-and post-lab-survey question of "How important is it for you to create accessible software?" to determine the impact our material. We conducted a dependent t-test over the two pairs of likert scores since each of them is given by a specific student. Table 1 summarizes the p-values from the t-tests and demonstrates that Group C has a higher positive impact on students than Group A.

Table 1: P-values of the t-tests for RQ1

Group	$\overline{pr}$	$\overline{po}$	$\overline{\Delta p}$	P-value
A	3.69	3.85	+0.17	0.04
B	3.93	4.05	+0.12	0.13
C	3.62	3.99	+0.37	$1e^{-4}$

This analysis demonstrates the positive impact that our material has in motivating students on the importance of computing accessibility education.

RQ2. *How effective are the labs in informing students about foundational accessibility principles?* We again compared Group A (existing material) against Group B & Group C (our created material). To better understand the impact that each set of material had on informing students about the addressed accessibility topic, we next evaluated the post activity quiz scores for participants in all groups.

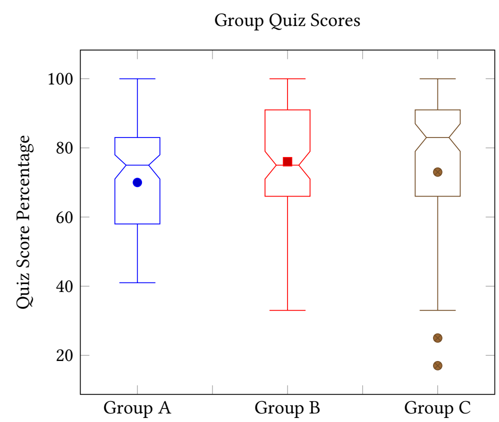


Figure 2: Student quiz scores for the three evaluation groups.

The higher quiz scores in Figure 2 demonstrate that our material has a higher positive impact in informing participants about foundational accessibility concepts.

RQ3. *How impactful are 'empathy-creating' materials in accessibility education?* Using a t-test, we compared Group B (our material with no empathy-creating components) against Group C (our material *with* empathy-creating components). We again used the pre- and post-survey question 'How important is it for you to create accessible software?'. Results indicate that Group C has a higher post/pre-lab-survey difference than Group B with the p-value of 0.04. In correlation with the observations from RQ1, our findings indicate that empathy-creating material has a positive impact on students feelings on the importance of creating accessible software.

4 LAB AVAILABILITY

Lab material is available on the project website: http://all.rit.edu

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