Challenges and Opportunities in Creating an Accessible Web Application for Learning Organic Chemistry

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Objective/Question

- What are the major web accessibility issues within organic chemistry resources?
- Are the 3D interactive features of webORA accessible?

Introduction

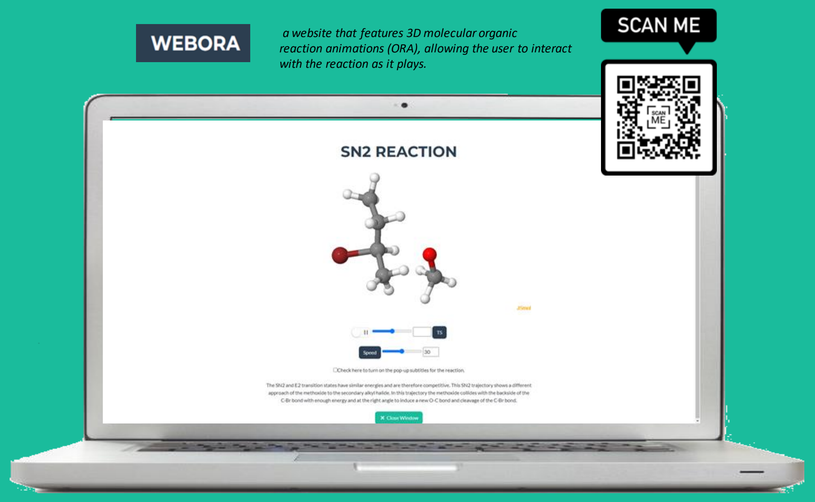
While students with disabilities demonstrate high interest in STEM during the transition from high school to college, their representation in STEM decreases throughout postsecondary education and into the workforce [1]. A strong foundation in organic chemistry leads to better understanding of other STEM subjects such as biochemistry, earth sciences, and biotechnology and leads to the creation of many everyday chemicals, petroleum products, plastics, and pharmaceuticals. (2).
After a thorough search, no organic chemistry educational website has addressed level AA accessibility, and therefore, none have met the Web Content Accessibility Guidelines (WCAG 2.0).

This study has 3 distinct contributions:

1. Investigated student's preferences on accessibility features while learning organic chemistry through a **questionnaire**
2. Conducted 12 **usability tests** using the beta version of webORA
3. Performed a manual **accessibility audit** of webORA

WEBORA

a website that features 3D molecular organic reaction animations (ORA), allowing the user to interact with the reaction as it plays.



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Methodology

1. Questionnaire

Purpose: Identify major problem areas within accessibility of organic chemistry resources.

Method: simple random sampling

- Administered at a public university based in Philadelphia, Pa USA.

2. Usability Tests

Key Tasks
Task 1: Try to rotate the molecule in any way you please. End with the configuring that helps you the most with your learning.
Task 2: Locate more written information about this reaction. Take a moment to read the text.
Task 3: Turn on the subtitles for the reaction.

Follow-up:
Was the website intuitive and easy to use as a first-time user?

Purpose: To gain feedback on the usability and intuitiveness of the webORA application for the target user.

Method:

1. Reached out previous questionnaire participants who indicated interest in a follow-up usability test as well as students registered with the university's disability resource center.
2. The 30-minute virtual usability test was conducted through zoom in which the same researcher conducted the test utilizing a usability test script

3. Manual Accessibility Audit

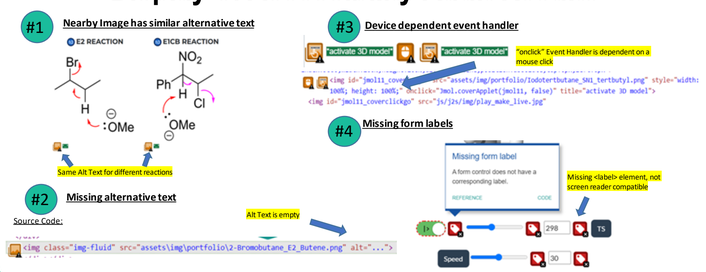
Purpose:
Gain a baseline of accessibility issues of the Sn2 reaction page of webORA

Tested against: WCAG 2.0 and Level AA standards [7]

Method:
Modified accessibility audit from an accessibility agency company.

Tools: Wave® by Webaim [3], a web accessibility evaluation online tool

Display of Accessibility Audit Results



References

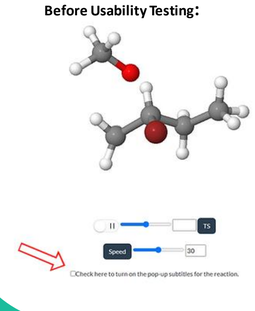
[1] Erin Scanlon, Zachary W Taylor, John Raible, Jacob Bates, and Jacquelyn J Chini. 2021. Physics webpages create barriers to participation for people with disabilities: five common web accessibility errors and possible solutions. International Journal of STEM Education 8, 1 (2021), 1–16.
[2] Organic Chemistry. American Chemical Society. (n.d.). Retrieved September 21, 2022, from https://www.acs.org/content/acs/en/careers/chemical-sciences/areas/organic-chemistry.html
[3] Webaim. 2022. WAVE Web Accessibility Evaluation Tool. (2022). https://wave.webaim.org/

Finding 1: Improving webORA's subtitles feature

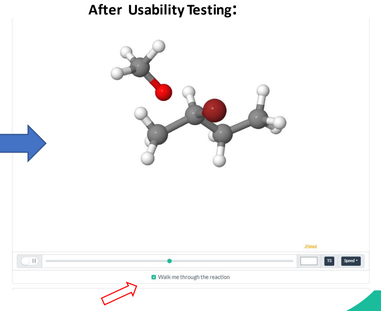
Finding 1: Improvement of the subtitle feature

Questionnaire results:
46 out of the 56 respondents agree subtitles help them understand the content of a video or animation
Usability Test results:
Students during the usability test suggested we rewrite the instructions for checking the box to be more clear

Before Usability Testing:



After Usability Testing:



Finding 2: Identification of Trackpad device-dependent event handler

Usability Test results:
Zooming in/out and rotating the molecules using a trackpad caused frustrations for most participants.

Accessibility Audit Key Results:

Issue Name	Description	Severity	Amount	Impact
Device Dependent Event Handler	Event handlers are triggered by a browser or user event (ex. User clicks a mouse). • Device dependent event handlers are dependent upon use of a mouse (or touch) or keyboard. • Device independent and are triggered by both the mouse/touch and keyboard, or by other means.	Critical	44	Those who navigate the web using a keyboard, will not be able to move the 3D molecule

Conclusion

This project sought to bring awareness to web accessibility in organic chemistry online resources. Through the usability testing of webORA, it was found to be usability and intuitive for first time users. webORA is still a work in progress.
Future Directions:

- Make device dependent event handlers with 3D interactive features more accessible to users using a keyboard to navigate the web.
- Explore other STEM disciplines to investigate if similar accessibility barriers exist