BITS Pilani
K K Birla Goa Campus

Integrating Accessibility Topics in Computing Education

Swaroop Joshi
Assistant Professor, Computer Sci & Information Systems, BITS Goa
swaroopjoshi.in

March 24, 2023

Brief Introduction

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- Ph. D. in Computer Sci. & Engg. – Ohio State University

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  - How to integrate accessibility topics in computing education
  - How to teach computing to persons with disabilities

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Teaching accessibility
≠
Teaching accessibly

Background

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- In our rapidly digitising world, it is important that software services we develop are *accessible* to anyone and everyone

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- RPD-2016
  - Equality and non-discrimination (3)
  - Protection from [..] exploitation (7)
  - Access to information and communication technology (42)

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News

QS World University Rankings by Subject for 2023

IIT Bombay has been ranked 1st in India and 47th globally in Engineering and Technology with an overall score of 80.4 out of 100 in the Quacquarelli Symonds

Announcements

- Inviting Nominations for IIT Bombay International Award 2023

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82

Accessibility

These checks highlight opportunities to improve the accessibility of your web app. Only a subset of accessibility issues can be automatically detected so manual testing is also encouraged.

NAMES AND LABELS

- Image elements do not have `[alt]` attributes
- Links do not have a discernible name

These are opportunities to improve the semantics of the controls in your application. This may enhance the experience for users of assistive technology, like a screen reader.

NAVIGATION

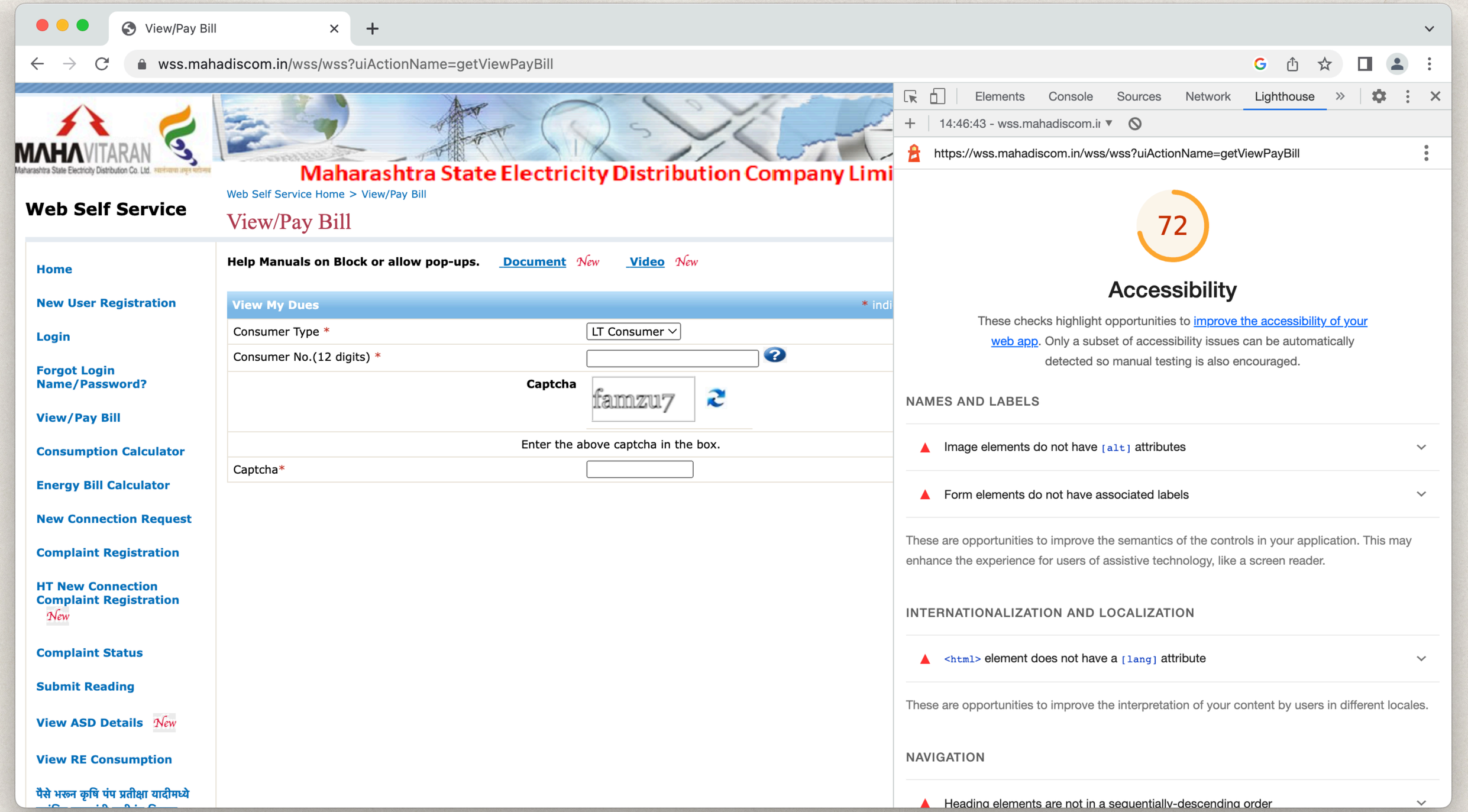
- Heading elements are not in a sequentially-descending order

These are opportunities to improve keyboard navigation in your application.

ADDITIONAL ITEMS TO MANUALLY CHECK (10)

Show

These items address areas which an automated testing tool cannot cover. Learn more in our guide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Maharashtra State Electricity Distribution Co. Ltd.
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72
Accessibility
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NAMES AND LABELS
Image elements do not have [alt] attributes
Form elements do not have associated labels
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INTERNATIONALIZATION AND LOCALIZATION
<html> element does not have a [lang] attribute
These are opportunities to improve the interpretation of your content by users in different locales.
NAVIGATION
Heading elements are not in a sequentially-descending order

Welcome to Delhi Board

delhiboard.org.in

PUBLIC NOTICE

Due to Pendemic situation of **Covid-19**, Our all Staff and workers are doing work f
We have closed our office for randomly positive cases for Covid-19. Inbetween we a
to provide any appointment to visit our office, we are also not able to receive any lett
organization. If anyone require any information please mail to our office
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Main Menu

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- List of Examination Centre

Welcome to Delhi Board of Senior Secondary Education

Secondary education is the stage of education following primary education. Except in countries where only primary or basic education is compulsory, secondary education includes the final stage of compulsory education and in many countries it is entirely compulsory. Secondary education is characterised by transition from primary education to tertiary, post - secondary or higher education.

Higher Secondary Examination is a centralised examination of class 12. All the educational

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- Download
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- New Syllab

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60

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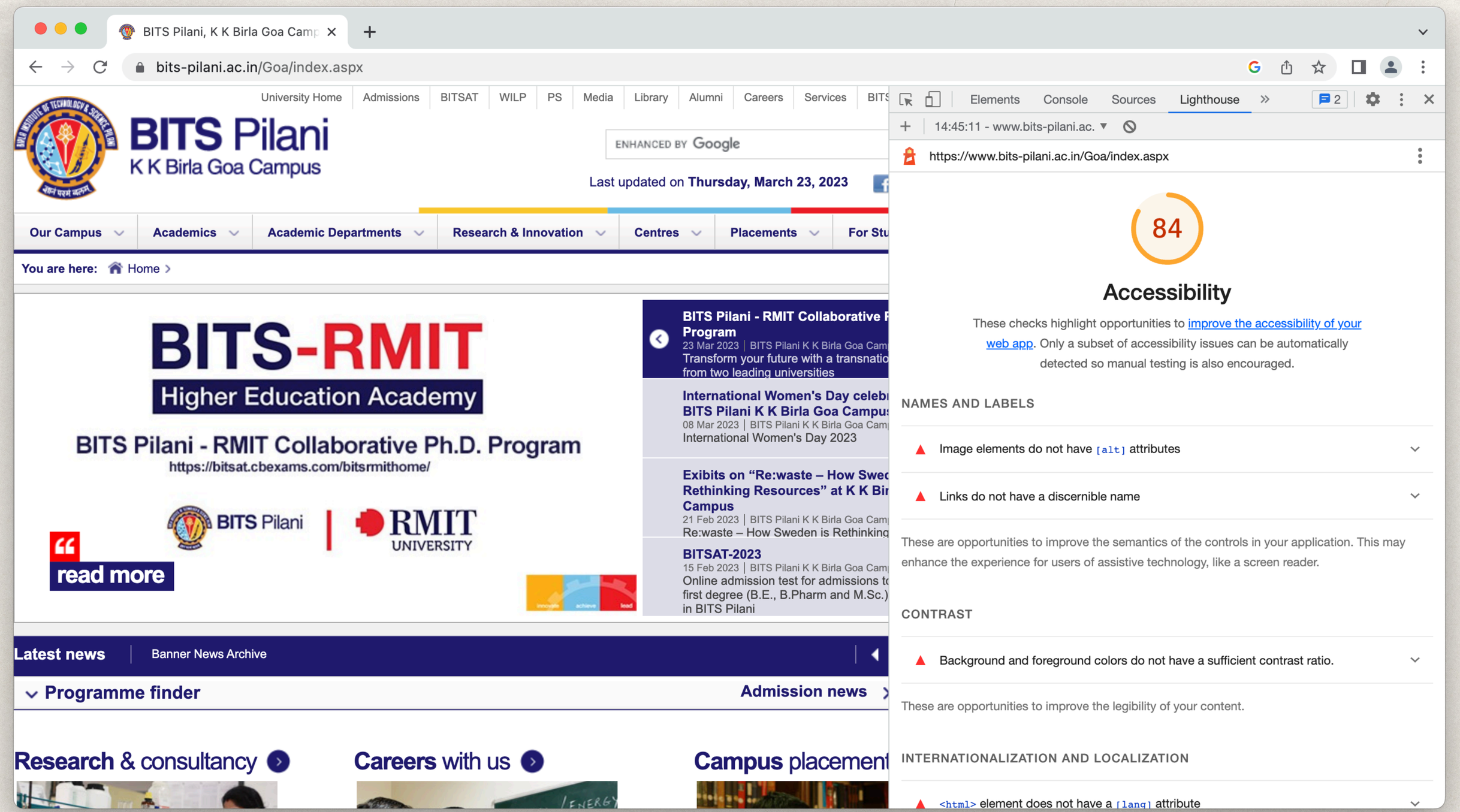
CONTRAST

- Background and foreground colors do not have a sufficient contrast ratio.

These are opportunities to improve the legibility of your content.

INTERNATIONALIZATION AND LOCALIZATION

- `<html>` element does not have a `[lang]` attribute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Re:waste – How Sweden is Rethinking
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84
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- Who teaches accessibility – a survey of 14,000+ CS faculty in the US (Shinohara et al., 2018)
  - 2.5% of the overall faculty, at least one in ~50% institutes
  - Barriers:
    - Not a core part of curriculum
    - Lack of knowledge on the teachers' part

Background

Background

- Incorporating accessibility topics in
  - HCI (Palan et al., 2017)
  - Assistive technology (Matausch et al., 2006)
  - Web dev (Freire et al., 2013)
  - Software engineering (El-glaly et al., 2020)
  - …

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  - Accessibility awareness
  - Technical knowledge
  - Empathy
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- Modes of teaching
  - Modifying a lecture
  - Adding a lecture
  - Adding a course
  - Accessibility as a theme

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The course

- CSF314: Software Development for Portable Devices
  - Android app development using Java
  - Third/final year CS majors (~75)
  - Prereq: OOP, Software engineering; most have done summer internships
  - Online due to COVID19
  - Four programming assignments (30), Exams (55), In-class activities (15)

Interventions

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- Lectures – Android accessibility guidelines, TalkBack, Accessibility Scanner, UI testing for accessibility (week 4)
- Programming assignments – some software features (e.g., interact with a database) and some accessibility-related tasks worth 5-15% marks

Participants

Participants

- 50 out of 72 enrolled students signed the consent forms
- Ages 18 to 22
- 47 M, 3 F

Instruments

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(A) An inclusive thinking questionnaire at the start and end of the course

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(B) Reflective questions on accessibility as part of programming assignments

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(B) Reflective questions on accessibility as part of programming assignments

(C) Exam questions on applying accessibility knowledge

(A) Inclusive thinking questionnaire

(A) Inclusive thinking questionnaire

- Presents a hypothetical COVID vaccine verification scenario: all public movement is allowed but anyone (e.g., a restaurant owner) can ask anyone (e.g., a customer) to show a proof of vaccination.
  - What potential challenges do you see in the large-scale adoption of this solution?
  - Who will be your potential users for testing the prototype to gain feedback on the design?

(A) Inclusive thinking questionnaire

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- Open-ended questions

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- Two-pass magnitude coding

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- N = 40

(A) Inclusive thinking questionnaire

- Open-ended questions
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	Pre	Post
Infrastructure barriers	10	17
Diversity	25	27
Disabilities	1	17

(A) Inclusive thinking questionnaire

- Open-ended questions
- Two-pass magnitude coding
- N = 40

McNemar's test, p = 0.000177

	Pre	Post
Infrastructure barriers	10	17
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(B) Programming Assignments

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N = 50
TalkBack
Accessibility Scanner
Espresso
None
Marks for Accessibility

(B) Programming Assignments

N = 50	A1
TalkBack	49
Accessibility Scanner	49
Espresso	
None	1
Marks for Accessibility	5

(B) Programming Assignments

N = 50	A1	A2
TalkBack	49	35
Accessibility Scanner	49	8
Espresso		33
None	1	6
Marks for Accessibility	5	15

(B) Programming Assignments

N = 50	A1	A2	A3
TalkBack	49	35	7
Accessibility Scanner	49	8	6
Espresso		33	15
None	1	6	35
Marks for Accessibility	5	15	10

(B) Programming Assignments

N = 50	A1	A2	A3	A4
TalkBack	49	35	**7**	**4**
Accessibility Scanner	49	**8**	**6**	**8**
Espresso		33	15	**9**
None	1	6	35	41
Marks for Accessibility	5	15	10	0

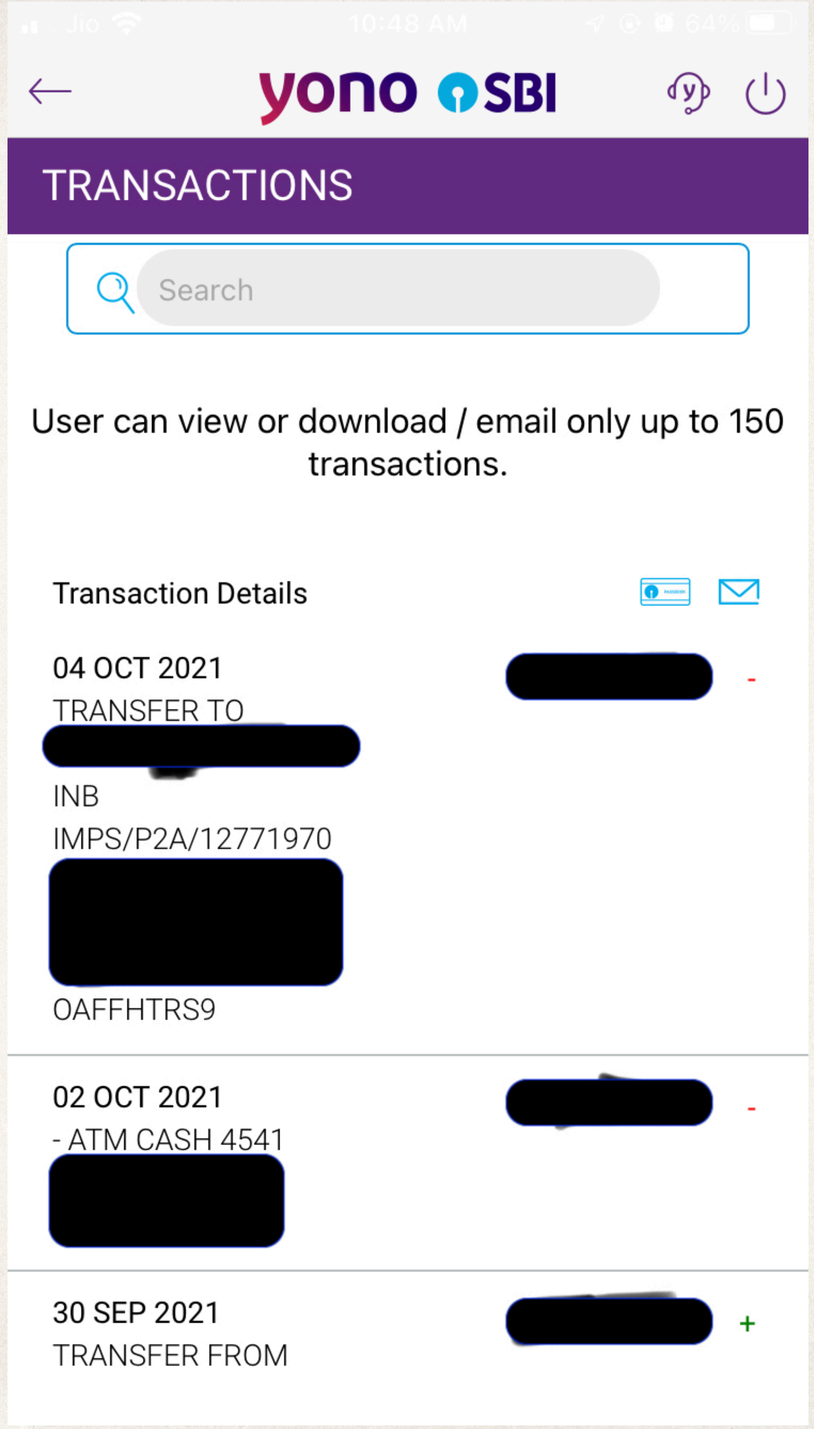
(B) Programming Assignments

8 others couldn't do accessibility testing due to lack of time

N = 50	A1	A2	A3	A4
TalkBack	49	35	7	4
Accessibility Scanner	49	8	6	8
Espresso		33	15	9
None	1	6	35	41
Marks for Accessibility	5	15	10	0

(C) Exam questions

- Midterm (30/100 marks): identify at least three UI elements that are likely to have accessibility issues and explain how you will fix those issues.



(C) Exam questions

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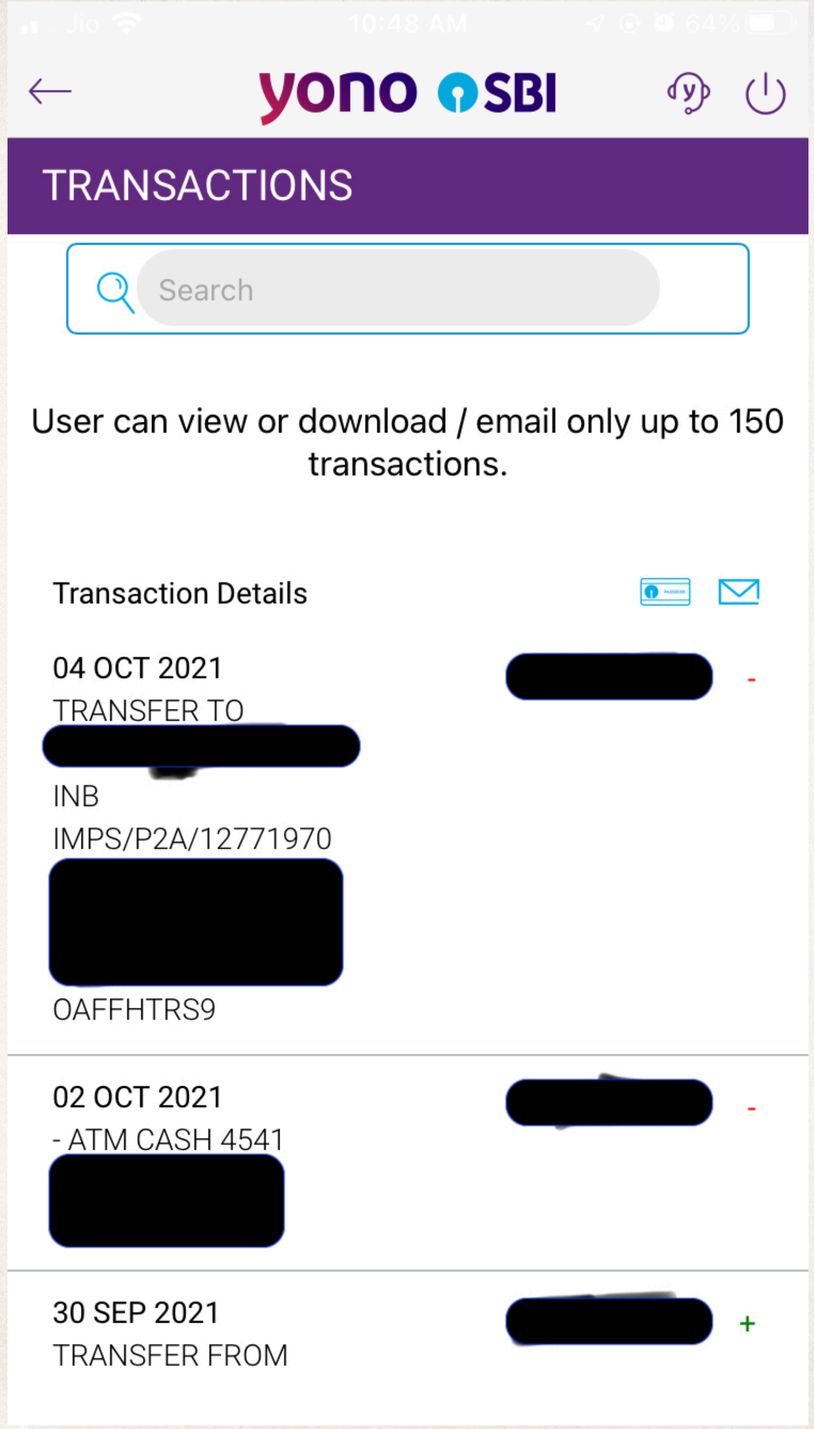
	N=50
Identified three issues	26
Identified one or two	24
Proposed valid fixes	40



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- Final exam (20/100 marks): showed an XML code that represents UI in Android (input boxes for title and author, button for submit), containing accessibility flaws
  - Identify accessibility issues TalkBack will highlight.
  - Identify accessibility issues TalkBack will *not* highlight.

(C) Exam questions

- Final e ved an XML c ndroid (input button for sub ity flaws

(i) Input boxes do not have 'hint-text'
(ii) contentDescription of the button is redundant

  - Identify accessibility issues TalkBack will highlight.

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(i) Low colour contrast
(ii) Small clickable widget size

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N = 50		
TalkBack Capabilities	Correctly identified	49
	Misidentified	18
TalkBack Limitations	Correctly identified	42
	Misidentified	11

LOs: Accessibility Awareness

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- More students considered disabilities when answering the question on designing a vaccine verification app at the end of the course

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- 17 students considered accessibility testing in A4 even when there were no marks for that → intrinsic goal orientation

LOs: Technical knowledge

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Not exposed to such examples in assignments, only covered in lecture

LOs: Empathy

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- Not directly measured
- Visible in student self reflection on assignments after using their app blindfolded
- “I realised why [this exercise] is important as using TalkBack people with disabilities can also use the applications.”

Limitations and future work

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- Interacting with PWDs can add to empathy and motivation
- Reflection questions v. Actual student code/work
- Long-term retention?

Also working on

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    - 4 respondents disagree/strongly disagree → none has a close relation who is PWD

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Followed by 1-1 interviews
RAs currently transcribing

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- Industry survey

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  - Reached out via personal contacts, BITS alumni network

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- One PhD student exploring gamification for teaching accessibility esp in industry

Conclusion

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- Lack of instructions/support in mainstream CS education
- Need to develop modules/resources faculty can easily integrate in their existing courses
- Various opportunities in this broad space
  - interest from govt / NGOs → need to educate them about ‘education research’

References

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Thank you!

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