An Analysis of the Effectiveness of an Online Inclusive Design Curriculum Through the Lens of Inclusive Design PCKs

by
Aishwarya Vellanki

A THESIS

submitted to
Oregon State University
Honors College

in partial fulfillment of
the requirements for the
degree of

Honors Baccalaureate of Science in Computer Science
(Honors Scholar)

Presented November 29, 2021
Commencement June 2022
The online computer science classroom is growing, but there is little research on how to teach inclusive design online. As a result, online CS students are graduating without learning how to avoid bias in their software designs. Through the lens of the Inclusive Design Pedagogical Content Knowledge (PCK), this thesis analyzes a set of curricular activities that were embedded into online post-baccalaureate computer science courses. The contributions of this work include: (1) a set of takeaways outlining what I learned from student responses to the activities and (2) the second iteration of the Inclusive Design PCKs that can be applied in both the online and in-person classrooms.

Keywords: Human-centered computing, computer science education, online learning

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I understand that my project will become part of the permanent collection of Oregon State University, Honors College. My signature below authorizes release of my project to any reader upon request.

_________________________
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1 Introduction

The GenderMag Project [Burnett et al. 2016] has found that software is biased against women and has developed “inclusive design” methods that can find and fix these biases [Burnett et al. 2017, Burnett et al. 2016, Cunningham et al. 2016, Hilderbrand et al. 2020, Mendez et al. 2019, Padala et al. 2020, Shekhar & Marsden 2018] but inclusive design is typically pushed aside and not incorporated into mainstream computer science education [Raji et al. 2021]. To help remedy this, easily-consumable guidance is needed to make it easier for educators to teach inclusive design. Techniques and knowledge—Pedagogical Content Knowledge (PCK)—that can assist educators in teaching inclusive design for in-person classes have already been developed but it is not known whether these PCKs can be applied and are relevant to online courses, which are rapidly growing in popularity. For example, in Fall 2021, the Oregon State University CS Ecampus post-baccalaureate program was almost twice the size of the on-campus undergraduate program (2,124 students versus 1,187).

As part of a larger study with a larger team [Letaw et al. 2021], I helped to develop a set of 11 curricular activities for teaching inclusive design online that served as an input to my individual project (see Figure 1 and see Letaw et al. 2021b for the activities in downloadable form). That project (covered by this thesis) is an extension of the larger project and its aim is to examine these curricular activities to determine whether the existing PCKs for teaching inclusive design can be applied to teaching inclusive design in online courses, how their application might be different in the online context, and what gaps exist that might call for PCK modifications. The research question guiding this thesis is: To what extent are the PCKs developed for teaching inclusive design in-person relevant to the online classroom?

This thesis will cover the following:

1. An analysis of 11 inclusive design activities, developed for the online classroom, through the lens of the Inclusive Design PCKs,
2. Takeaways for educators and education researchers on implementing activities with the Inclusive Design PCKs in mind, and
3. A recommended second iteration of the Inclusive Design PCKs to be used for online and in-person instruction.
2 Background

Inclusive design is to design in a manner that supports diverse users, and ultimately any user for a given service or product [Clarkson et al. 2013]. The inclusive design material used in our curriculum was GenderMag (Section 2.1). The curriculum and curricular activities were created based on the theory foundations (Section 2.2). I analyzed the curriculum through the lens of the Inclusive Design PCKs (Section 2.3) to determine their applicability in the online environment.

2.1 GenderMag Foundations and Inclusive Design Methods

GenderMag consists of foundational research findings (“foundations”) and derived inclusive design inspection methods (“methods”). At the core of GenderMag are five facets which reflect a range of cognitive approaches people use when interacting with technology. These include: one’s motivation to use the technology (task completion or tech interest), their information processing style (comprehensive or selective), computer self-efficacy (low or high), attitude toward risk (risk-averse or risk-tolerant), and style of learning new technologies (process-orientated or by tinkering) [Burnett et al. 2016]. These facets drive three distinct personas, Abi, Tim, and Pat, who reflect a fixed subset of the possible facet values. Abi, for instance, is only motivated to use technology for completing tasks, has a comprehensive information processing style, has low computer self-efficacy, is risk-averse, and is process-orientated when learning new technologies.
Figure 2: A breakdown of the Abi persona. All text highlighted in blue are content that can be modified (non-essential). All of the text in red and black is fundamental to Abi and cannot be modified [Burnett et al. 2016].

Tim, on the other hand, reflects facet values that are the opposite to those of Abi. Pat falls somewhere in between Abi and Tim, and reflects some values from each of the other two personas including some unique to just Pat. Women commonly exhibit Abi’s facet values, and men commonly exhibit Tim’s facet values [Burnett et al. 2016]. However, this does not constrain these personas to only one gender, nor does it mean that a person will always think and behave as an Abi, Pat, or Tim. Time and circumstances can change how a person approaches a situation.

One of the GenderMag methods is a set of 9 heuristics, called the GenderMag Heuristics, or Cognitive Style Heuristics (CSH) [GenderMag 2021b]. An example of one CSH is shown in Figure 3.
The CSH are designed to be used within a heuristic evaluation [Nielsen 1990] performed by software designers. Each of the CSH support the three personas by giving a guideline for how to design software and descriptions of how following the guideline supports facet values of different personas. The application of these heuristics can therefore help software practitioners to create an inclusive technology that takes into consideration how those with differing cognitive styles problem-solve when interacting with a technology that they are seeing for the first time.

2.2 Theory Foundations

Course materials development was guided by two theoretical foundations: Ecampus Essentials [OSU Ecampus 2021] and Community of Inquiry [Garrison et al. 1999].

The Ecampus Essentials [OSU Ecampus 2021] are a set of guidelines developed by Oregon State University for guiding instructional designers and educators on designing an online or hybrid curriculum based off of the Quality Matters Higher Education Rubric. The essential elements are identified by 9 categories: 1) Course Introduction and Navigation, 2) Learning Outcomes and Alignment, 3) Assessment and Feedback, 4) Instructional Materials, 5) Interaction and
Engagement, 6) Course Technology, 7) Learner Support, 8) Accessibility, 9) Academic Integrity. Ecampus Essentials provided a roadmap for approaching the redesign of the Software Development course. This map helped us to determine the overall strength of the course, identified ways in which the course could be strengthened, and principles for embedding the activities into the course.

The Community of Inquiry (CoI) educational framework [Garrison et al. 1999] (shown in Figure 4) provided perspective on how we could develop the curricular activities to be more engaging for students. It is used for distanced, online learning. CoI identifies three areas of focus—Social, Cognitive, and Teaching presence—that all play an interrelated role in helping create a learning community that is collaborative and meaningful.

![Community of Inquiry Diagram](image)

**Figure 4:** Each of the three CoI elements (Social, Cognitive, and Teaching presences) have an interrelated relationship towards creating a successful online learning environment. Cognitive presence is most directly related to success in higher education. However, the social and teaching presences play key roles in helping to facilitate and strengthen the cognitive presence [Garrison et al. 1999].

### 2.3 PCKs for Teaching Inclusive Design

Pedagogical Content Knowledge (PCK) identifies the gaps in knowledge that educators need pertaining to the techniques and the content knowledge needed to teach a specific topic [Shulman 1987]. The research study by Oleson et al. [Oleson et al. 2018] defined a set of PCKs that addressed common challenges faced by educators when teaching the GenderMag foundations and walkthrough method in an in-person classroom setting. The 11 PCKs are categorized into 7 areas as seen in Table 1.

<table>
<thead>
<tr>
<th>PCK</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Framing</td>
<td>Providing foundations first can give...</td>
</tr>
<tr>
<td>PCK for teaching the foundations</td>
<td>students the capacity to understand and engage with inclusive design methods.</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>PCK 2-Credibility: Providing students with credible resources can convince students that inclusive design methods are valid and useful.</td>
<td></td>
</tr>
<tr>
<td>PCK for teaching the personas and facets</td>
<td>PCK 3-Content Knowledge: Content knowledge of the facets can help teachers explain to students each facet’s impacts on how a user might interact with software.</td>
</tr>
<tr>
<td>PCK 4-Concretization: Reframing facets in concrete ways to explain persona behavior can model how students should use the facets to predict persona behavior.</td>
<td></td>
</tr>
<tr>
<td>PCK for teaching the process itself</td>
<td>PCK 5-Modeling: Modeling correct process for students both before and during hands-on practice can help students improve their use of an inclusive design process.</td>
</tr>
<tr>
<td>PCK for increasing students’ application of “Theory of Mind”</td>
<td>PCK 6-Theory Of Mind: Coaching students to immerse themselves in the persona can help them with their “Theory of Mind” abilities to see software through the eyes of a persona.</td>
</tr>
<tr>
<td>PCK 7-Averting “I”: Listening for uses of “I” during in-class activities and prompting students to instead use the personas’ names can reduce use of “I” methodology and increase perspective-taking.</td>
<td></td>
</tr>
<tr>
<td>PCK for reducing “I” methodology</td>
<td>PCK 8-Engagement: Tasking students to modify non-essential parts of inclusive design method materials, such as background information, can increase engagement with the materials through a heightened sense of ownership.</td>
</tr>
<tr>
<td>PCK 9-Refuting Stereotypes: Pointing students to the evidence underlying inclusive design methods’ foundations can help students connect their inclusive design work to foundations rather than stereotypes.</td>
<td></td>
</tr>
<tr>
<td>PCK for addressing gender biases</td>
<td>PCK 10-Reducing Stereotypes: Having students perform the inclusive design process, such as through an in-class activity, can reduce tendencies to stereotype members of populations unlike themselves.</td>
</tr>
<tr>
<td>PCK for addressing resistant learners</td>
<td>PCK 11-Handling Resistance: Relating inclusive design methods’ utility to the broader goal of inclusive appeal and/or to greater market share can mitigate the risk of students’ resistance and motivate them to learn inclusive design.</td>
</tr>
</tbody>
</table>
3 Method

To achieve the goals of our research, we employed the action research method [Hayes 2014], to allow us to make adjustments as new findings were discovered. Our research is split into three phases. The first two phases were designed to answer the research questions for the inclusivity lens research. The research questions were [Letaw et al. 2021]:

- RQ1: How do these curricular interventions affect the climate among online CS students?
- RQ2: How do these curricular interventions affect online CS students’ respect for users’ diversity, and their ability to create more inclusive technology for these users

The first phase was an exploratory phase intended to test the Exploration activity (to be used in the Software Engineering <CS-SE> curriculum) in a smaller way through a single Extra-Credit Assignment with Databases <CS-DB> students (see Table 2). Through the exploratory phase we were able to identify the strengths and weaknesses of the Exploration activity. We made needed adjustments to the Exploration before beginning the confirmatory phase. The second phase, or confirmatory phase, consisted of redesigning the CS-SE course curriculum, and hypothesis testing.

Table 1: 7 categories of 11 PCKs to teach Inclusive Design developed by Oleson et al. [Oleson et al. 2018]

<table>
<thead>
<tr>
<th>Course</th>
<th>When</th>
<th>#</th>
<th>Activity</th>
<th>Who involved</th>
<th>COI Presence(s)</th>
<th>PCK(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-DB</td>
<td>Week 7</td>
<td>1</td>
<td>Exploration</td>
<td>Individual</td>
<td>Cognitive, Social</td>
<td>2, 4, 5, 11</td>
</tr>
<tr>
<td></td>
<td>Week 7</td>
<td>2</td>
<td>Extra Credit Assignment (reflection / application)</td>
<td>Individual</td>
<td>Cognitive</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2: CS-DB students did the Exploration and Extra-Credit Assignment during one week of their course. The last three columns describe who was involved (just the individual student and/or the team), and identify the CoI presences and PCKs that they support.

The third phase of the research, which is the topic of this thesis, was my effort to answer the third research question:
- RQ3: To what extent are the PCKs developed for teaching inclusive design in-person relevant to the online classroom?

To do so, I analyzed each of the activities to determine which PCKs were applicable. I determined applicability of a PCK by checking to see if the intended outcome came as a result of the mitigation strategy identified by the PCK.

### 3.2 The curriculum & curricular materials

After gathering information during the exploratory phase, we prepared to integrate inclusive design throughout CS-SE by first evaluating the existing course using the Ecampus Essentials rubric to determine how well it supported the online learning experience. Having gained an understanding of where there needed to be adjustments or improvements, we used the 9 principles outlined in Ecampus Essentials [OSU Ecampus 2021] as guidelines for incorporating GenderMag concepts into the online CS-SE curriculum. We created the curricular materials (Table 3) by balancing each of the three elements in the CoI framework.

<table>
<thead>
<tr>
<th>Course</th>
<th>When</th>
<th>#</th>
<th>Activity</th>
<th>Who involved</th>
<th>COI Presence(s)</th>
<th>PCK(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-SE</td>
<td>Weeks 1+2</td>
<td>3</td>
<td>Exploration</td>
<td>Individual</td>
<td>Cognitive, Social, Teaching</td>
<td>1, 2, 4, 5, 11</td>
</tr>
<tr>
<td></td>
<td>Weeks 1+2</td>
<td>4</td>
<td>HW1 (facet reflection)</td>
<td>Individual</td>
<td>Cognitive, Social, Teaching</td>
<td>1, 4, 8</td>
</tr>
<tr>
<td></td>
<td>Weeks 1+2</td>
<td>5</td>
<td>HW1 (design / evaluate / revise)</td>
<td>Individual</td>
<td>Cognitive, Teaching</td>
<td>5,10</td>
</tr>
<tr>
<td></td>
<td>Weeks 1+2</td>
<td>6</td>
<td>Learning Quiz</td>
<td>Individual</td>
<td>Cognitive, Teaching</td>
<td>1, 4</td>
</tr>
<tr>
<td></td>
<td>Weeks 1+2</td>
<td>7</td>
<td>Team Facet Discussion</td>
<td>Team</td>
<td>Cognitive, Social, Teaching</td>
<td>4, 9</td>
</tr>
<tr>
<td></td>
<td>Weeks 5+6</td>
<td>8</td>
<td>HW3 (integration with others’ designs)</td>
<td>Team</td>
<td>Social, Teaching</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Weeks 5+6</td>
<td>9</td>
<td>Peer Heuristic Evaluation, HW3</td>
<td>Classmates, Team</td>
<td>Cognitive, Teaching</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 3: CS-SE students did activities 3-11 over the span of an entire term. The last three columns describe who was involved (just the individual student and/or the team), and identify the CoI presences and PCKs that they support.

3.3 The participants

The participants for this research study consisted of 75 students and five instructors at Oregon State University. All of the student participants were enrolled in the online, post-baccalaureate computer science degree program. One of the instructors was a GenderMag expert, who was also the primary researcher of the inclusive lens research study. The other four instructors were novices to GenderMag, but had incorporated GenderMag concepts into their online course curriculums. Two of the instructors taught CS-SE, three taught CS-DB, and one taught a course for non-CS majors.

3.4 Data and Analysis

We gathered student data from five online classes: three terms of an Introduction to Databases course (CS-DB), and two of a Software Engineering (CS-SE) course (one being the source of baseline data). Students who opted in to the research study agreed to share their course assignments and the data collected from questionnaires. The CS-DB student participants filled out a post-questionnaire, and the CS-SE student participants filled out both a pre- and post-questionnaire. We collected data from the five instructors through semi-structured interviews and feedback questionnaires. The interviews focused on the challenges the instructors faced with their content knowledge of GenderMag, especially in situations where questions or comments were raised by students on the content.

We analyzed the data qualitatively, examining student responses throughout all of the activities and questionnaires mentioned earlier in this section to find evidence of the challenges faced in the in-person section, as well as instances of improvement as a result of the mitigation strategies.
4 Results: Activities Implementation & Student Response

The discussion of the results will be structured in the following manner. After definitions (Section 4.1), each subsection will begin with a short description of the activity itself. Then, the PCK(s) that are mapped to each activity will be discussed in further detail and takeaways for the activity will be listed at the end of the subsection.

4.1 Definitions

Oleson et al. [2018] used several terms throughout the text of the PCKs that I will refer to throughout this results section. Our interpretation of those terms follows.

- **Foundations**: The personas, facets, and facet values produced by GenderMag.
- **Engagement**: A personal investment to understand and apply the material. [Newmann 1992]
- **Inclusive design methods/processes**: Any GenderMag process which applies the foundations to software design.
- **Inclusive Appeal**: The attraction behind supporting a diverse set of users.

4.2 Exploration (Activities 1,3)

The Exploration introduced students to the GenderMag foundations and heuristics. This was a reading-based activity that provided students with background information on GenderMag research, thorough descriptions and examples for each of the Cognitive Style Heuristics and their effect on each of the personas [GenderMag 2021b], and an embedded quiz for students to test their understanding of the heuristics.

**PCK 1: Framing**

The Exploration activity was introduced in the first week of the term for CS-SE students (see Table 3). Students demonstrated their understanding and engagement with both the foundations and inclusive design methods in later course activities and feedback assignments.

Applying PCK 1 in the online context made sense but, because the educator would be “blind” (not be able to see student reactions or answer student questions in real-time), we designed several activities (Activities 5,6,7) to reinforce the Exploration content and gauge students’ understanding and engagement with the GenderMag foundations. Additionally, these activities helped us to determine whether introducing the foundations early on led to helping students better understand and engage with the inclusive methods.
However, there was evidence that the Exploration alone prompted student engagement regarding inclusivity. For example, one student noted a personal change in their views as a result of learning the foundations, saying, “Prior to reading this module, I didn't ever consider that there were cognitive reasons behind the way I interact with software...Now, I feel more considerate of others and the way they interact with software too, and I think I'm going to be more patient and understanding of those who are more risk-averse than I am” (P33842, Week 1 Homework Assignment). After completing the course, this student brought out that they applied what they learned to another class, saying, “[I now consider] different cognitive styles [when I design UIs.] ... I had a web app project due for CS340, and I provided instructions to make it easier for the user to interact with the site” (P33842, Week 11 Post-Questionnaire). This result may not be a direct outcome of the Exploration, however, we can see that the student was engaged from the beginning of the course and put forth effort to personally understand and internalize the foundations. Then, the student showed the same spirit when choosing to apply the inclusive design method outside their course.

**PCK 2: Credibility**

To address issues of credibility raised in the exploratory phase of the research, we implemented changes during the confirmatory phase that emphasized the credibility of the intervention content. After implementation, we saw no evidence of students challenging the credibility of the content. Instead, they expressed that the content was both valid and useful.

In the exploratory phase, we iterated on the Exploration activity two times in CS-DB, preparing for it to be the core inclusive design content for the CS-SE course. While a majority of the CS-DB students did not raise any issues regarding the credibility of the material, a couple seemed to have doubts. One student questioned whether the intervention content was research-based, saying, “I do not know, though, if it is a general fact that most women tend to use software like that personality. If there is research behind that, I would genuinely be very interested in reading it” (P915, Week 7 Extra-Credit Assignment). Another CS-DB student stated they “would have liked to see more of the studies and materials that led to the conclusions” (P022, Post Questionnaire). Additionally, when CS-DB students were explicitly asked on the post-questionnaire whether they perceived the exploration to be research-based, the participants answered either ‘maybe,’ or ‘no.’

Based on how students responded, we decided to slightly revise the Exploration. Initially, we had tried to emphasize credibility by providing a reference to the research paper, *Fixing Inclusivity Bugs for Information Processing Styles and Learning Styles* [Steine-Hanson et al. 2019], and explicitly stating that the heuristics were developed by a “leader in usability research,” and were “based on research” in the Exploration. To strengthen the credibility of the Exploration content, we took three actions.
The first change we made was to bold parts of sentences that emphasized the credibility of the intervention content, such as when mentioning that the heuristics were “created by a research team,” and that they were “based on research about different ways people problem-solve in software”. Research on the effects of font on learning and memory states that, “bolded text has a higher recall than text in italic or regular styles, regardless of the font size” [Delgado 2021]. Bolding important words might have been especially helpful to students who are selective information processors, as they tend to skip content that does not stand out to them.

The second action we took was to include, as one of the learning goals for the activity, “Learn the background and research behind Cognitive Style Heuristics and Personas”. For students who look to learning goals for guidance, those goals can lead them to notice the key points of the reading/activity such as the GenderMag research basis [Eberly 2019].

The last action we took was to include an additional research article in the references. After these changes were made, of the 34 students CS-SE participants in the confirmatory phase, there were zero instances of students questioning the credibility of the material in the course feedback. In fact, several CS-SE students applied their learning even outside the classroom. For example, one student said in the post-questionnaire that they used their learning in another class: “...I had a web app project due for CS340, and I provided instructions to make it easier for the user to interact with the site.” (P33842, Week 11 Post Questionnaire)

This activity validates PCK 2 because we provided students with resources on research supporting GenderMag and were able to see evidence that students found the inclusive design methods to be useful. However, because we also saw evidence that not all students were convinced of the credibility of the material with just the resources, we found that by taking additional steps we could further mitigate this problem.

**PCK 4: Concretization**

We designed persona cards (Figure 5) as a way to provide relatable, concrete examples to the students, and, following the CoI framework, to increase the teaching presence in the course [Fiock 2020, Garrison et al. 1999]. Therefore, these cards would serve a dual purpose of being 1) another opportunity for students to see concrete examples and 2) a way to introduce the instructional team to the students in a personal way. The persona cards were shared with students as part of Activity 3 in the first week of the CS-SE course. An example of one instructor’s persona card with examples of facet values are shown in Figure 6.
Figure 5: A persona card template for the instructional team. This template includes the instructional team member’s name, an identification of two facet values, and spaces to describe each of the identified facet values in detail.

Figure 6: Filled persona card of CS-SE instructor, Lara.

While none of our participants commented on the persona cards having helped them predict persona behavior, we did see evidence of the cards supporting teaching presence. One student commented, “it was so cool that we were able to see how the instructor and our TA’s define their personas. Understanding people as people and not just the recipient at an email address makes the process of learning so much more expansive!” (P30018, Week 1 Team Discussion).

PCK 5: Modeling(V)
We modeled how to apply each of the 9 Cognitive Styles Heuristics (current version has 8 [GenderMag 2021b]) with pictures and notes (example in Figure 3). A student noted how helpful it was having these examples in Activity 3, saying, “...having real examples of the 9 heuristics was a great way to give me a concrete understanding of the techniques in action” (P37307, Week 1 Team Discussion).

**PCK 11: Handling Resistance**

The first iteration of the Exploration activity used with CS-DB students spoke to the inclusive appeal of the GenderMag Heuristics stating that they “are used to find and fix gender bias bugs in software,” and “they are an inexpensive way to make a UI more usable”. CS-DB students commented saying that they found the material to be useful and showed motivation for wanting to continue using the foundations. For example, after finishing the Exploration Activity, one student noted the following: “I would refer to these heuristics as a software developer to ensure that the software I create is user-friendly for all kinds of users. I would want to make sure that I am not being biased in designing the software.” (P057, Week 7 Extra-Credit Assignment) Another student commented, saying, “...I'm definitely going to apply the content whenever I design or work on a project...User base is critical so making improvements to increase your user base (and improving their comfort with your product) is good.” (P109, Week 7 Extra-Credit Assignment) To address concerns later discussed in Section 5.1, for the second iteration of the Exploration activity (used in the confirmatory phase) we introduced the GenderMag Heuristics as the Cognitive Style Heuristics, and included a background section in the Exploration Activity which outlined how the cognitive styles contribute to the broader goals of inclusive design and the profitability of software (Figure 7).

![Background](image)

**Figure 7:** The background section of the Exploration used in the confirmatory phase of the study emphasizes the greater benefits of using the cognitive styles.

One concern that was raised in Oleson et al.’s work by an educator was that “[The] title for the project ... will turn people off before they understand how valuable it is” [Oleson et al. 2018]. To mitigate this, we chose to consistently use the terminology, Cognitive Styles Heuristics instead of GenderMag Heuristics.
Additionally, more subtle efforts, such as showing a diverse group of people for each of the personas, could have helped to reinforce the inclusiveness of the material (see Figure 8). One student expressed their appreciation for the diversity represented in the material, saying, “The more I reflect on the material, the more *I appreciate the adoption of these personas that specifically ignore age and gender*...I have always felt uncomfortable with the idea of my students and younger generations as "digital natives," and I think this exploration helped to solidify just why” (P30774, Week 1 Team Discussion). Such comments as this reinforce that students might be swayed away from the material if they feel it feeds into stereotypes (e.g. because they may be personally dealing with the negative effects of stereotypes). Therefore, having diversity in the visual representations of the cognitive styles could help reduce initial resistance students may have towards the material.

![Figure 8: Each of the personas is visually represented by a diverse group of people who are of different genders, ages, and races.](image)

**Activities 1,3 Takeaways:**
- Instructional team persona cards are opportunities to model how facet values can be personally applied while also engendering a teaching presence
- Students appreciated having concrete examples of how the heuristics can be applied
- Visually emphasizing statements regarding the research behind GenderMag might help students notice its credibility
- Incorporating GenderMag into student learning goals might help guide students to notice its credibility
- Diverse visual representations for the personas can reinforce the broader benefits of inclusive design

### 4.3 Extra-Credit Assignment (Activity 2)

CS-DB students were given the opportunity to complete the extra-credit inclusive design assignment shown in Figure 9.
Figure 9: The CS-DB Extra-Credit activity prompted students to provide their thoughts on the Exploration activity and come up with their own example(s) for applying the heuristics.

PCK 4: Concretization
As part of the assignment, students were prompted to come up with their own examples of applying the Cognitive Style Heuristics, which helped them concretize how the facets relate to inclusive software design. As an example of how students responded to this prompt with concrete examples and predicted persona behavior, one student said, in providing an example for how Heuristic #9 could be applied, “...I could implement popups that encourage slowing down the over-tinkerers (ex: make them reaffirm they would like to take some action. I could also implement on-hover suggestions for under-tinkerers so they don’t miss out on the features they might otherwise have overlooked” (P819, Week 7 Extra-Credit Assignment). While the student’s imagined scenario could have been more concrete, they nonetheless came up with reasonable suggestions for how to accommodate both Abi and Tim learning styles.

Activity 2 Takeaways:
- Asking students to come up with personally-relevant examples can help them to better understand how those with different cognitive styles interact with software

4.4 Homework 1 Facet Reflection (Activity 4)
After reading through the Exploration activity, CS-SE students were asked to self-reflect. The reflection guided them through a series of prompts, as shown in Figures 10 and 11.
PCK 1: Framing
A facet self-reflection can enhance framing by reinforcing the foundations to students (going beyond providing the foundations, the suggested PCK 1 action). It can also support student social presence by giving them an opportunity to participate in the course as their “real” selves. Student responses indicated that they connected with the foundations (see example in Figure 10).

PCK 4: Concretization
Activity 4 was another way of framing facets to students in concrete ways, but there was no evidence it helped students predict persona behavior (they were only asked to discuss their own behavior). Students responded to the activity by giving specific examples of both their facet values and how their facet values related to specific scenarios. For example, one student noted, “I am most like Abi in regard to her information processing style. For example, in my coursework, I like to read through the entire homework assignment before starting” (P37283, Week 1 Facet Reflection). Furthermore, when asked how the student may reflect Tim’s facet values, they said, “I identify with Tim’s interest-centric motivation to learn technology….I...enjoy downloading the newest iPhone software and recently had fun optimizing my widgets” (P37283, Week 1 Facet Reflection). Additionally, the activity might help students be more comfortable expressing aspects of their identity that can be stripped away in the online environment. As students bring in their personal experiences into their learning, this can help to facilitate their critical thinking with the material [Garrison et al. 1999].
Figure 11: (Left) Second part of the Facet Reflection activity prompting students to think about situations where they exhibit Abi and Tim’s facet values, identify situations when their facet values may change, and how it affects their understanding of how the student uses software. (Right) A sample student submission (P30774, Week 1 Facet Reflection).

PCK 8: Engagement
Student responses to this activity also suggested it could provide another way to prompt inclusive design engagement besides “modifying non-essential elements of inclusive design method materials”, which is not relevant to the Cognitive Styles Heuristics (they have no modifiable elements).

Activity 4 Takeaways:
- To get evidence that foundations have been adequately provided to online students (needed for PCK 1), educators can assign activities that reinforce the foundations. This suggests rewording PCK 1 to mention foundation reinforcement.
- Reflection activities are another way to help students engage with inclusive design. This suggests rewording PCK 8 to include this activity type.
- In the online environment, educators may not have a chance to reframe facets in concrete ways because they often are not interacting with students synchronously. This suggests educators may need to preempt the problem by providing concretion upfront, including by prompting students to create their own concrete examples. This also suggests a wording change so that PCK 4 does not imply a synchronous reaction to student behavior.
- This activity can help students bring their “real selves” into the classroom, which supports social presence.
4.5 Homework 1 Design Process (Activity 5)

In addition to the self reflection, students evaluated their paper prototypes against a subset of the Cognitive Style Heuristics (#2, #3, #4), as shown in Figure 12.

![Figure 12: (Left) Heuristic Evaluation model assignment. (Right) Student assignment.](image)

**PCK 5: Modeling**

As part of Activity 5, I created an example submission to demonstrate the assignment expectations to students, including before and after screenshots of the software design showing the changes made to support 3 of the 9 heuristics (see Appendix). While I cannot say for sure whether students' performance in implementing the heuristics improved because they saw an example, the example provides one possible implementation of modeling.

**PCK 10: Reducing Stereotypes**

While Activity 5 involved performing the inclusive design process (as suggested in PCK 10), the activity did not necessarily help reduce stereotyping, as the inclusive design process was a heuristic evaluation and not the GenderMag walkthrough used in [Oleson et al. 2018]. The walkthrough requires that a student channel the Abi persona, which Hill et al. suggest can reduce stereotyping [Hill et al. 2017], but the GenderMag heuristic evaluation does not require a persona.

**Activity 5 Takeaways:**
- The Activity 5 model assignment provides an example to students for how to do a
GenderMag heuristic evaluation (provided in Appendix).

- It might not be reasonable to expect a GenderMag heuristic evaluation to reduce stereotyping because it does not involve actively using a persona. This suggests PCK 10 could be clarified to mention walkthroughs specifically instead of the more general “inclusive design process” terminology.

### 4.6 Learning Quiz (Activity 6)

The learning quiz tested students’ knowledge and understanding of the Cognitive Style Heuristics. The quiz posed questions about the foundations such as, “If Abi is told a task will require high effort, how might that affect them?,” but also questions that helped students connect the foundations (knowledge of the personas, in this case) to the inclusive design methods (application of the Cognitive Style Heuristics, in this case) as seen in Figure 13.

There was no limit on the number of attempts the quiz could be taken. Students were advised to take the quiz at least twice, the first time without notes.

**PCK 4: Concretization**

The learning quiz can be a way of testing students’ understanding of the material by having them work in two directions: 1) asking students to work backwards from concrete examples to the foundations and 2) starting from the foundations and connecting it to concrete examples. This is another opportunity to reinforce the student’s understanding of the foundations and conceptual understanding of the inclusive design method before having them perform the process.

<table>
<thead>
<tr>
<th>Question 15</th>
<th>1 pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Abi’s are women and all Tim’s are men. True or false?</td>
<td></td>
</tr>
<tr>
<td>○ True</td>
<td></td>
</tr>
<tr>
<td>○ False</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question 12</th>
<th>1 pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why might Abi want to see what existing features do, and why they are useful?</td>
<td></td>
</tr>
<tr>
<td>Select ALL correct answers.</td>
<td></td>
</tr>
<tr>
<td>□ So they can avoid unfamiliar features that might make the task take longer.</td>
<td></td>
</tr>
<tr>
<td>□ Abi always likes exploring without considering time or utility risks.</td>
<td></td>
</tr>
<tr>
<td>□ Abi likes to know what’s going on before investing effort.</td>
<td></td>
</tr>
</tbody>
</table>
Figure 13: Sample questions from the learning quiz testing student’s understanding of the foundations and their connection to the heuristics.

PCK 1: Framing
In addition to testing for their understanding of the material, we also looked for signs of engagement with the foundations. Many students expressed wanting to learn and use the foundations. One student engaged by making an especially strong effort to understand the foundations: “At first I was a bit lost going through the exploration. I was having a hard time keeping the three personas distinct from one another. However, once I took the quiz (several times), I started to see the differences among each user.” (P30774, Week 1 Team Discussion)

Later in the course, the student mentioned engaging with the inclusive design methods outside of school: “The cognitive styles also proved useful in a manufacturing training project I am consulting on right now” (P34512, Week 10 HW5).

Activity 6 Takeaway:
- We saw evidence that early engagement with the foundations was an indicator for later engagement with the inclusive design methods. Therefore, Providing AND REINFORCING foundations first can give students the capacity to understand and engage with inclusive design methods. This provides additional justification for rewording PCK 1 (previously suggested in the Activity 4 Takeaways).

4.7 Team Facet Discussion (Activity 7)
In a group discussion with their teammates (Figure 14), students discussed their thoughts on the Exploration activity, and how they connected with the foundations. Students also discussed how their facet values were similar and different from two of their teammates.

Since this is a group discussion, each group has its own conversation for this topic. Here are the ones you have access to:

1.5 · Team Discussion: Cognitive Styles
To begin getting to know your team, do the following:
1. Complete the Cognitive Styles Heuristics Exploration
2. Contribute to this team discussion by doing the following:
   a. Describe your thoughts about the exploration (at least one paragraph)
   b. State which personas you identify with and describe two of your facet values
   c. Respond to two different people. Include how your facet values are similar or different from your teammate’s.

Figure 14: The Team Discussion prompted students to share how they connected with the foundations, by prompting them to state which personas they identified with along with describing
two of their facet values. Students were also prompted to relate with each other by commenting on how they were similar or different from their teammates.

PCK 4: Concretization
The team discussion on facet values can help students generate concrete examples in a couple of ways. First, for facet values that students cannot relate to, the team discussion is an opportunity for students to gain insight on how facet values, that are polar to their own, can be related to real-world examples. Secondly, seeing differing concrete examples on the same facet value can broaden a student’s view of how that facet value can be applied. In reply to a teammate, one student shared, “I am the opposite of you in your willingness to take risks!...You mention how you downloaded new iOS software, well, I cling to whatever software I have all the way until one of the apps I use becomes incompatible with it” (P30683, Week 1 Team Discussion).

PCK 9: Refuting Stereotypes
Finding similarities with other students and being able to talk about differences in a neutral way can help students talk about patterns of behavior without crossing over into the realm of stereotyping. For example, one student brought out that, “The cognitive styles were useful in discussions with my teammates when getting to know each other because they were a non-intimidating way to neutrally express our confidences and capabilities.” (P30018, Week 9/10 HW5)

Activity 7 Takeaway(s):
- Having students share concrete examples of cognitive styles with classmates can give them new perspectives on their cognitive styles.
- Open communication can be facilitated between students by means of the cognitive styles.

4.8 Homework 3 Design Integration (Activity 8)
After creating their own designs in Activity 5, students coordinated with their team to combine each of their feature designs to create an entire GUI prototype. None of the PCKs applied to this activity.

4.9 Peer Heuristic Evaluation, HW 3 Design Revision (Activity 9)
In a group discussion with classmates from different teams, students shared prototypes of their projects, provided feedback, and received feedback. Each student was to evaluate at least one other team’s design using 8 of the 9 Cognitive Style Heuristics (#2-#9).

PCK 10: Reducing Stereotypes
We designed this activity as another opportunity for students to practice the inclusive design process (heuristic evaluation). This activity was different from the students’ first time practicing the heuristic evaluation (Activity 5) because they evaluated other students’ designs and not their own. However, as mentioned in Activity 5, it might not be reasonable to expect PCK 10 to be validated with a heuristic evaluation to reduce stereotyping.

Figure 15: The second of two times that the CS-SE students performed an inclusive design process (Heuristic Evaluation) in the course.

4.10 Homework 5 Climate and Users Reflections (Activity 10)

Towards the end of the course, students were asked to reflect on how knowledge of the cognitive styles affected their interactions and perspectives of their teammates and users (Figure 16). Both questions prompt the students to think about how learning the CSH affected their interactions and views of others. One student in response to the second question (in Figure 15) said: “Now when I think of users using a piece of software I don’t picture them as I am, a Tim just jumping in and tinkering with a software. I am more aware that there are others like Abi and Pat who have their own interests in using a software which might not align with mine” (P33965, Week 10 Cognitive Styles Reflection). None of the PCKs applied to this activity.
Cognitive Styles Final Reflection

In what ways did the cognitive styles discussion affect interactions with your teammates? (At least two sentences)

Reflection

In what ways did learning about cognitive styles affect the way you view users? (At least two sentences)

Reflection

Figure 16: Section of HW5 prompting students to reflect on how the cognitive styles affected their interactions with teammates and their view of users.

4.11 Extra-Credit Course Feedback (Activity 11)

At the end of the term, students were able to leave additional feedback on the cognitive styles, stating the positive/negative effects of them, and why the material may or may not be useful in the future (Figure 17). We designed this activity with the intention of helping students to recognize the cognitive milestone they’ve reached in their learning of inclusive design and what this means for their future. By reflecting on the journey leading up to this milestone, we wanted to remind students of the stance they’ve come to take towards inclusive design concepts and the reasons behind that. Although we didn’t directly ask students about how learning the cognitive styles affected their views of others in this reflection, students still brought it out as a positive reason for learning. For example, one student commented on a personal benefit of learning the cognitive styles, saying: “...I think it has given me empathy. When I see my teacher colleagues struggle with technology, especially in this context of the pandemic, I will view them with more compassion and less judgement than before” (P30774, Week 11 Extra-Credit Course Feedback). Furthermore, we wanted to help students see how this learning can be carried along with them into their future in other courses, as professionals, etc. One student showed that they were already applying what they learned outside the class, relating: “Just recently, I started helping students do paper prototyping for a game they want to design, and I brought up the personas as a way to consider their UI/UX work. I imagine these cognitive styles will stick with me indefinitely as I continue working with software” (P30774, Week 10 Course Feedback). This activity alone may not help students to become less resistant to the material. However, if students have worked towards tearing down the wall of resistance and building a wall of reason accompanied by positive experiences throughout the course, this is an opportunity to reinforce these efforts. None of the PCKs applied to this activity.
5 Discussion

The results of the *inclusivity* lens analysis are discussed in detail in [Letaw et al. 2021].

The discussion begins with pitfalls we observed regarding implementation of the 11 activities, with recommended mitigations (Section 5.1).

In addition, the takeaways derived from the *PCK* lens analysis identify areas in which a subset of the existing Inclusive Design PCKs can be revised to support teaching inclusive design in the online classroom, and teaching inclusive design in general (Section 5.2).

5.1 Pitfalls & Recommendations

Within the course of the exploration and confirmatory phases of the research, we came across some pitfalls in teaching the GenderMag content. I have some recommendations for how these pitfalls can be avoided or helped.

**Pitfall 1: Students seeing one of their facet values as a deficit.**

Some students talked about their facet values as negative aspects of their cognition even though none of the facet values are inherently worse than others. For example, one student said, “*Not proud* of this, but I’m a **selective information processor** the majority of the time. I try to go for the broad strokes of what certain information might be trying to relay. I’m **working on being**
more comprehensive” (P31766, Week 1 HW1). Another student had the opposite opinion: “I'm probably a bit more comprehensive in my information processing as well, which is probably often a detriment to me” (P35173, Week 1 Team Discussion).

Although educators might not be able to entirely guide students away from deficit thinking, there may be ways to help students see that each facet value has benefits. For example, if the instructional team models talking about one’s own facet values, doing so in a neutral or balanced way might help students adopt a more complete perspective. An anti-example is shown in Figure 18.

![Instructor Profile Card](image.png)

Figure 18: In the instructor profile card used in the CS-SE course, the instructor provided an example of being risk-tolerant but, in the course of explaining their example, used strong, possibly negative language that could move students to think that being risk-tolerant also means behaving carelessly or violently.

**Pitfall 2: Students interpreting foundations as promoting stereotypes.**

In the exploratory phase of the research, a couple students expressed that they felt the content was stereotyping men and women. For example, on the first version of the Exploration activity, a CS-DB student commented the following in the post-questionnaire: “I might not use the specific heuristics because it will just bring to mind the gender stereotype orientedness of the heuristics” (P915, Post Questionnaire). One factor that might have contributed to how this and another student felt was that we initially decided not to include the Pat persona in the
Exploration. Seeing just the Abi and Tim personas could have communicated to the students that all women are like Abi and all men are like Tim. Therefore, in the updated version of the Exploration, we followed a recommendation from The GenderMag Project on their GenderMag-Teach website FAQ to also include the Pat persona [GenderMag 2021c], who represents people who exhibit a mixture of facet values between Abi and Tim [Burnett et al. 2016] (Figure 19).

Figure 19: Excerpts of the three GenderMag personas, including Pat.

For each of the heuristics, we also added a statement describing how one or more of Pat’s facet values are related to the heuristic and how Pat can be supported. Finally, we emphasized that most people are a mixture of Abi and Tim and that an individual’s facet values can change with time and circumstance.

Including the Pat persona did not resolve the problem of students thinking that the content promoted stereotypes. However, of the 34 CS-SE students that were exposed to all three of the personas, only 2 raised concerns regarding stereotypes. Furthermore, we saw notable evidence of
student’s having an expanded view of thinking as a result of learning GenderMag. For example, one student said, “Like many of you, I had no idea there were archetypes of software users. I thought it was more of a binary thing where someone had computer literacy or not. It totally makes sense that different personality types approach software use in different ways. Software should be designed with this in mind. I wish this knowledge was more widespread. Not sure how prevalent it is throughout the industry” (P34598, Week 1 Team Discussion). Another student also noted a change in their attitude and thinking saying, “I typically think... in terms of a simple dichotomy of those who are good with tech and those who aren't. Now I see that I probably was being... inaccurate in my assessment of others” (P30774, Week 1 Team Discussion).

5.2 Suggested Revisions to Inclusive Design PCKs

The analysis of the curricular materials through the Inclusive Design PCK lens revealed some areas where the PCKs could be improved to better support online learning and inclusive design learning in general. Table 4 lists the recommended revisions to the Inclusive Design PCKs.

<table>
<thead>
<tr>
<th>PCK</th>
<th>Revised?</th>
<th>Recommended PCK Text</th>
<th>Mapped to Activities (I, V):</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Framing</td>
<td>✓</td>
<td>Having students learn the foundations first, through active learning, can give them the capacity to understand and engage with inclusive design methods.</td>
<td>Original PCK: 3(I) \  Revised PCK: 4(V), 6(V)</td>
</tr>
<tr>
<td>2 - Credibility</td>
<td>✓</td>
<td>Showing and emphasizing to students data supporting the legitimacy of inclusive design can convince them that inclusive design methods are valid and useful.</td>
<td>Original PCK: 1(I) \  Revised PCK: 3(V)</td>
</tr>
<tr>
<td>3 - Content</td>
<td></td>
<td>Knowledge of the facets can help teachers explain to students each facet’s impacts on how a user might interact with software.</td>
<td></td>
</tr>
<tr>
<td>4 - Concretization</td>
<td>✓</td>
<td>Framing facets in concrete ways to explain persona behavior can model how students should use the facets to predict persona behavior.</td>
<td>Revised PCK: 1(I), 2(V), 3(I), 4(I), 6(I), 7(I)</td>
</tr>
</tbody>
</table>

Footnote 1: For inclusive design methods involving cognitive facets, such as GenderMag or other InclusiveMag-derived methods.
<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
<th>Description</th>
<th>Original PCK:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Modeling</td>
<td>Modeling correct process for students both before and during hands-on practice can help students improve their use of an inclusive design process.</td>
<td>1(I), 3(V), 5(I)</td>
</tr>
<tr>
<td>6</td>
<td>Theory of Mind</td>
<td>Coaching students to immerse themselves in the persona can help them with their “Theory of Mind” abilities to see software through the eyes of a persona.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Averting “I”</td>
<td>Listening for uses of “I” during in-class activities and prompting students to instead use the personas’ names can reduce use of “I” methodology and increase perspective-taking.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Engagement</td>
<td>✓ Tasking students to modify non-essential parts of inclusive design method materials, such as background information, or to personally relate to the foundations, can increase engagement with the materials through a heightened sense of ownership.</td>
<td>Revised PCK: 4(V)</td>
</tr>
<tr>
<td>9</td>
<td>Refuting Stereotypes</td>
<td>Pointing students to the evidence underlying inclusive design methods’ foundations can help students connect their inclusive design work to foundations rather than stereotypes.</td>
<td>Original PCK: 7(V)</td>
</tr>
<tr>
<td>10</td>
<td>Reducing Stereotypes</td>
<td>✓ Having students perform the inclusive design process can reduce tendencies to stereotype members of populations unlike themselves.</td>
<td>Original PCK: 5(I), 9(I)</td>
</tr>
<tr>
<td>11</td>
<td>Handling Resistance</td>
<td>Relating inclusive design methods’ utility to the broader goal of inclusive appeal and/or to greater market share can mitigate the risk of students’ resistance and motivate them to learn inclusive design.</td>
<td>Original PCK: 1(V), 3(I)</td>
</tr>
</tbody>
</table>

Table 4: PCKs 1, 2, 4, 8, 10 have been revised to reflect the results of my analysis. The Activities mapped column identifies the activities to which either the original or revised PCK applied. Each activity is denoted with an I, or V. ‘I’ means that we followed the mitigation strategy offered by a
PCK, but the results are unknown (i.e., the PCK was applied, but the expected results were not observed or able to be measured). ‘V’ means that the activity validates a PCK (i.e., we applied the PCK action as suggested and saw evidence of the intended outcome for that PCK).

5.3 Limitations

PCKs not mapped

The scope of this study was only two courses—CS-SE and CS-DB—so not all the PCKs were applicable to an activity. Because of this, I could not analyze online relevance for the PCKs about Content Knowledge (PCK 3), Theory of Mind (PCK 6), and Averting “I” (PCK 7). I was able to map all other PCKs to the online environment. Each of these unmapped PCKs will be spoken about in further detail.

PCK 3 - Content Knowledge: Although the online instructors I interviewed did not face issues specific to knowledge about facets, they faced similar challenges with not having the content knowledge necessary to incorporate GenderMag into their classes and when addressing student’s questions and comments. Therefore, I looked into how these instructors dealt with these challenges and whether the actions taken were beneficial.

The interviewed instructors identified what resources they used for dealing with situations where they felt they didn’t have enough information to effectively teach. Two instructors stated that they would reference the GenderMag website as a source for content knowledge. However, one instructor expressed that, when more involved questions regarding GenderMag arose from students, they did not feel confident about answering the questions, or even in their ability to find the answer. In one event, where a student asked broader questions regarding the data supporting GenderMag on a discussion board, the instructor noted how the student’s questions made them feel, saying, “I got a bit intimidated by the question... I did not know where to start” (PT639). The instructor identified one of the reasons they felt they weren’t able to respond to the student’s questions was because they had not fully read a GenderMag research paper, and were only a novice in their understanding of GenderMag. The first strategy the instructor used was to pull in a GenderMag expert into the conversation to help answer the student’s questions. Although the student’s doubts may not have been addressed to the student’s satisfaction, the instructor felt supported and felt that they were able to learn from the expert’s interaction with the student on how they can address such questions. Later as a follow-up or conclusion to that discussion thread, the instructor provided two concrete examples communicating how bad user interface designs can result in profit loss, and how a lack of understanding of the users can be physically detrimental. These mitigation strategies gave satisfactory support to both the instructor and student. However, further research will have to be done to determine how instructors can be best supported when incorporating either in part or in whole GenderMag content.
PCK 6 - Theory of Mind: We saw instances of students acknowledging others as being different from them, or that there are different types of users. However, we did not see evidence of student’s placing themselves into the shoes of a persona (theory of mind) and viewing software through that persona as a result of persona immersion. In the instances where student’s predicted persona behavior it is unclear which activity, if any, was the instigator for this way of thinking.

PCK 7 - Averting “I”: Our research did not use the GenderMag walkthrough as the inclusive design method so this PCK was not applicable to the activities we designed. However, the assumption could be made that if the GenderMag walkthrough were to be taught in an asynchronous online environment, there would need to be changes to address the fact that an educator cannot immediately correct a student who uses “I” when conducting the walkthrough. Possibly, instructing students to not use “I” as part of the instructions, and having students video record themselves during the walkthrough, could help students to be kept accountable. Other techniques that were mentioned in this paper, such as visual emphasis and modeling, could also be beneficial.

6 Concluding Remarks

In this paper I have provided an in-depth analysis of the 11 curricular activities designed to teach inclusive design in an online environment. A majority of the PCKs (8/11) were applicable at least in part to the online curriculum. The primary takeaways from student responses to the curricular activities indicated students understood and engaged with the foundations and inclusive design method. This analysis prompted suggested revisions for 5 of the 11 Inclusive Design PCKs to better support teaching inclusive design.
References


[Oleson et al. 2018] Oleson, Alannah, Christopher Mendez, Zoe Steine-Hanson, Claudia Hilderbrand, Christopher Perdria, Margaret Burnett, and Amy J. Ko. "Pedagogical content


Appendix

Heuristic Evaluation Example

Medium-Fidelity Prototype
Usability Evaluation

**Heuristic #2: Explain what existing features do, and why they are useful**

I do not think the prototype does a good job of meeting this heuristic. None of the features on the website are explained as to what they do or why they might be useful.

**Heuristic #3: Let people gather as much information as they want, and no more than they want**

I think that the filtering option naturally fulfills the goal of this heuristic. On the listing page, users can filter out items that don’t meet their criteria, or can choose to look at all the items at once. The favorite, hide, and trash icons also act like the filter to help the user narrow down the search items. There may be other parts of the prototype that could benefit from this heuristic.

**Heuristic #4: Keep familiar features available**

Since this is a revamp of the existing Craigslist website, several features from the existing website are kept the same. These include the following:

- Homepage: the names of the categories, search bar, centralized location name
- Listing Page: favorite and trash icons, filtering option, breadcrumb trail, and ability to change page view (grid or list)
- Item page: favorite, hide, and flag icons, breadcrumb trail
Heuristic #2: Explain what existing features do, and why they are useful

I thought of two ways to meet this heuristic. The first way is to maybe have an automatic pop-up tip or a statement on the listing page and/or item page that notifies users that clicking on the ‘favorite’ icon (the star) an item stores the item in their favorites to help find items faster. The second way is to display the tooltip when a user hovers over the favorite icon.
Heuristic #3: Let people gather as much information as they want, and no more than they want

In addition to the filtering option and icon which allow the user to control the amount of information they are exposed to, my group also created a contact button on the item page which will show the user the contact information of the seller only when clicked on. This reduces the amount of text information on the page.

Heuristic #4: Keep familiar features available

We didn’t make any changes for this last heuristic because we kept many features from the existing website in our prototype. Here are a couple examples:
The favorite and trash icons are still on each item. The names of the categories are the same.