RESEARCH-ARTICLE

How Students Value Technology vs. Paper-Based Resources in CS1 in Prison

EMMA HOGAN, University of California, San Diego, San Diego, CA, United States

ZYANYA RIOS, University of California, San Diego, San Diego, CA, United States

EMILY NGUYEN, University of California, San Diego, San Diego, CA, United States

ADALBERT GERALD SOOSAI RAJ, University of California, San Diego, San Diego, CA, United States

WILLIAM G. GRISWOLD, University of California, San Diego, San Diego, CA, United States

LEO PORTER, University of California, San Diego, San Diego, CA, United States

Open Access Support provided by:

University of California, San Diego

Published: 14 July 2025

Citation in BibTeX format

RESPECT 2025: Conference for Research on Equitable and Sustained Participation in Engineering, Computing, and Technology
July 14 - 16, 2025
NJ, Newark, USA

Conference Sponsors:
SIGCSE

https://doi.org/10.1145/3704637.3734765
ISBN: 9798400706264

How Students Value Technology vs. Paper-Based Resources in CS1 in Prison

Emma Hogan
University of California, San Diego
La Jolla, CA, USA

Zyanya Rios
University of California, San Diego
La Jolla, CA, USA

Emily Nguyen
University of California, San Diego
La Jolla, CA, USA

Adalbert Gerald Soosai Raj
University of California, San Diego
La Jolla, CA, USA

William G Griswold
University of California, San Diego
La Jolla, CA, USA

Leo Porter
University of California, San Diego
La Jolla, CA, USA

Abstract

Supplemental resources have particular importance in prison learning contexts, as incarcerated students have less access to course staff and limited ability to seek additional resources themselves (e.g., restricted internet access). In this paper, we examine how students valued paper-based (e.g., textbook) and technology-based (e.g., Canvas discussion board) resources in two iterations of a CS1 course taught in prison. Students in the first iteration did not have access to a code interpreter, while students in the second iteration did. Findings include how students across these two CS1 offerings valued different resources, compared across students' age and comfort with technology.

CCS Concepts

• **Social and professional topics** → **Computing education**; **Adult education**; **CS1**.

Keywords

Adult Learners, Prison Education, CS1

ACM Reference Format:
Emma Hogan, Zyanya Rios, Emily Nguyen, Adalbert Gerald Soosai Raj, William G Griswold, and Leo Porter. 2025. How Students Value Technology vs. Paper-Based Resources in CS1 in Prison. In *Proceedings of the 2025 Conference for Research on Equitable and Sustained Participation in Engineering, Computing, and Technology (RESPECT 2025), July 14–16, 2025, Newark, NJ, USA*. ACM, New York, NY, USA, 9 pages. https://doi.org/10.1145/3704637.3734765

1 Introduction

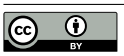
The "digital divide" imposed on individuals who are incarcerated has a special significance for the majority of adults in prison who are either currently pursuing, or wish to pursue, higher education [5, 27]: while incarcerated students in 17 states have access to computers and a technology-based mode of communication with instructors outside of class at least once per week [27], persisting challenges such as limit the utility of these devices for educational purposes—a major argument for their availability to incarcerated people in the first place [5, 8, 28]. For CS education specifically, limited educational technology hinders students more so than in other disciplines, specifically humanities. Hogan et al. note that while it is one of several factors contributing to the near total lack of STEM opportunities included in growing numbers higher education in prison programs, lacking technology infrastructure continues to be a significant barrier with little progress since it was first reported in CS education literature on teaching in prison in 1990 [2, 4, 18].

2 Theoretical Framework

The andragogy framework outlining tenets for adult education emphasizes the individuality of adults, necessitating the freedom of self-direction in their education to leverage their personal histories and take into account their future goals [20, 26]. Its focus on student autonomy has a unique importance in the prison environment, where dehumanization is intentionally embedded [6, 11], and it has been employed in prior works on computing education in prison [16, 17]. However, andragogy has been subjected to substantial criticism since it was first introduced by Knowles in the 1960s, including that it a) lacks empirical evidence to support its underlying assumptions, and b) over-emphasizes individuality such that it fails to acknowledge collective learning structures, group identities, and social contexts [12, 26]. Consequently, on its own, andragogy may not capture the full experience of incarcerated students, as "a framework that does not account for social contexts is limited in its application within a setting so greatly impacted by both macro- and micro- sociocultural dynamics" [12]. The emerging field of critical andragogy, infusing traditional andragogy with elements of critical pedagogies, has been applied in prior works theorizing the experiences of justice-impacted individuals as it balances andragogical priority of personal agency with the development of critical consciousness in order to understand oneself in relation to social contexts—of special importance in an environment characterized by and manifesting many systems of oppression [12]. Thus, we employ critical andragogy as our theoretical lens for framing this work.

3 Research Questions

In this study, we take a closer examination of how students value different course resources across two offerings of a CS1 course in prison—one where students had access to a web-based code interpreter, and one where students did not. Building on growing work exploring barriers faced by adult learners in CS in general, we specifically consider age as a potential factor in students' overall



RESPECT 2025, July 14–16, 2025, Newark, NJ, USA

ACM ISBN 979-8-4007-1355-2/2025/07
https://doi.org/10.1145/3704637.3734765

comfort with technology and use of technology-based resources. Specifically, we propose the following research questions:

(1) How do incarcerated adult students' initial comfort-levels with technology compare across different age groups?
(2) How do incarcerated adult students value technology-based resources compared to other resources in CS1?
(3) How does this differ by students' age and comfort-level with technology?

4 Positionality

For the duration of the design and execution of this work, the research team was guided by recent works on implementing a critical theory lens in CS education research [19], and quantitative education research more broadly [13, 15]. We enacted these concepts by assembling a research team including individuals from diverse gender, racial, ethnic, and socio-economic backgrounds, and engaging in self and group reflections on the oppressive social structures that are manifested in the prison environment where this research takes place. We also continue to engage in learning opportunities, organizations, and communities intended to elevate our competency in supporting Black, Latine, Native, and Pacific Islander students who are underrepresented in computing, yet overrepresented in this study population and U.S. prison populations overall.

5 Related Works

5.1 Adult Learners in CS

A recent literature review by Agbo on CS education research focused on adult learners found several gaps in knowledge, including strategies for engaging adult learners informed by related existing educational theories such as andragogy. Prior work studying adults' attitudes toward programming, and the ability of a brief programming education encounter to shift these attitudes, found in a correlational analysis that initial attitudes toward programming worsened as age increased [9]. Specifically, additional thematic coding of open-ended survey-responses revealed that the most frequent qualitative codes representing initial attitudes toward programming were *too difficult to understand*, *something I've wanted to learn*, and *boring*. However, the analysis showed a significant positive impact from a brief, positive experience with programming on adults' attitudes, with the most frequent qualitative codes for post-attitudes being *something I can or want to learn*, *fun*, and *easy to start* [9].

Other recent studies have explicitly examined the experience of incarcerated adult (IA) students in CS. Nisser et al. conducted a mixed-methods study including IA participants in a synchronous, virtual web-design workshop in both male and female prisons. Themes from qualitative surveys revealed that students were positively impacted by the workshop, but, in part due to small sample sizes typical in prison education programs, results of quantitative pre- post-surveys on general and computer programming self-efficacy were not statistically significant. Recent studies have also explored challenges and strategies for teaching CS1 for-credit in a higher education in prison program [16, 17], building on Aman's 1990 experience report on a full computer science major offered in prison between the 1970s an early 1990s. In Hogan et al.'s associated experience report, the authors highlighted the importance of providing supplemental resources, leveraging the observed asset that incarcerated adult students are already "skilled independent learners" [17]. However, the students from this course lacked access to a code interpreter, and the availability of other technology resources was frequently interrupted.

5.2 Educational Technology in Prison

The great majority of prison facilities in the U.S. fall short of principles and standards for technology in prison as defined by experts in prison education, such as "ensur[ing] that incarcerated learners ... are able to continually develop 21st century skills consistent with what is expected outside prison settings" [5]. This work and others, including from computing education specifically, note that limited technology access is one of the major barriers limiting access to STEM education in prison [2, 5, 18, 22], in addition to creating a digital divide faced by many individuals transitioning out of incarceration [14]. Currently, increasing technology resources may itself pose risks of harmful consequences to incarcerated people who use or are accused of using the technology in ways other than the intended educational purpose approved by the institution. Punishments for these actions are almost certain to fall entirely on incarcerated people, not the educators or advocates who requested them [6], which could exacerbate the fact that people from minoritized gender and racial groups receive disproportionate punishment during incarceration [23]. In addition, employees of the corrections departments responsible for clearing educational technologies may face severe consequences in these situations, and little reward if the implementation goes as planned. Several recent studies have documented the limitations of current technology infrastructure in meeting the needs of incarcerated students [8, 28], and the added complexity of many dominant prison technology suppliers profiting off of inferior products [5, 25]. The challenges created by limited student access to critical technologies specifically for computing education in prisons (e.g., code interpreters) has been a focus of the limited existing work in this space, with documented strategies for adapting to these challenges including changes to resubmission policies and focused resources for debugging by hand [4, 17].

6 Research Design and Context

This work takes place in two offerings of a traditional CS1 course using Python, taught in-person inside a medium-maximum security male prison in the United States. The course was offered by a large public research university with an established program offering Bachelor's degrees in Sociology to individuals currently incarcerated at this prison who were accepted to transfer into the university. All currently incarcerated students who apply for this program must have already completed their Associate's degrees, which are offered at the same prison through a local community college. The CS1 course fulfilled a technology requirement toward students' degrees in Sociology, and during the years that this data was conducted it was the only option offered to do so. Thus, all students accepted into the program were required to take the CS1 course. The same instructor (the first author of this paper) taught the CS1 course in Fall 2022, 2023, and 2024. The data analyzed in this paper comes from the second and third offerings of the course (Fall

2023 and 2024), in which there were 20 and 28 students enrolled, respectively.

Since the CS1 course was first offered in Fall 2022, the instructor and other university affiliates of the program have worked with the prison to increase students' access to technology relevant to this course and others in the program. As of Fall 2023, students had relatively consistent access to Canvas on individual laptops, although access was restricted to certain physical areas. However, access to code interpreters of any kind was prohibited and disabled from student devices, in addition to web-access outside of Canvas. Thus, as an adaptation, the instructor allowed students to upload drafts of any practice code, including code for Programming Assignments (PAs) and Labs, via a Canvas Quiz. Once daily on weekdays, the course staff ran any code that was uploaded by students, and returned the output to them as feedback on the quiz along with comments on next steps. The instructor also created resources intended to help students with debugging in the absence of a way to run their own code, adopting strategies outlined in prior work on teaching CS1 in prison [17].

For the Fall 2024 offering of the course, prison administrators agreed to additionally enable access to a web-based code interpreter, Onlinegdb [1]. With the exception of the first week of the course (during which student laptops were all confiscated), and a short interruption in access to the website for one day in the middle of the course, students were able to run their own code using this website. However, as was offered to students in prior offerings of the course, the instructor gave students the option of completing assignments handwritten on paper—including Programming Assignments. While the instructorencouraged students to at least try using the technology resources, and especially the code interpreter, a few students opted to hand-write their code for assignments. The only technology resource that was required as part of students' grades was peer code reviews, which were conducted via Canvas discussion boards four times during both offerings of the course. Also, a Canvas discussion board for Open Q&A was available throughout both offerings of the course, which students could use to ask any course related questions and maintain communication with the instructor outside of in-person lectures and office hours.

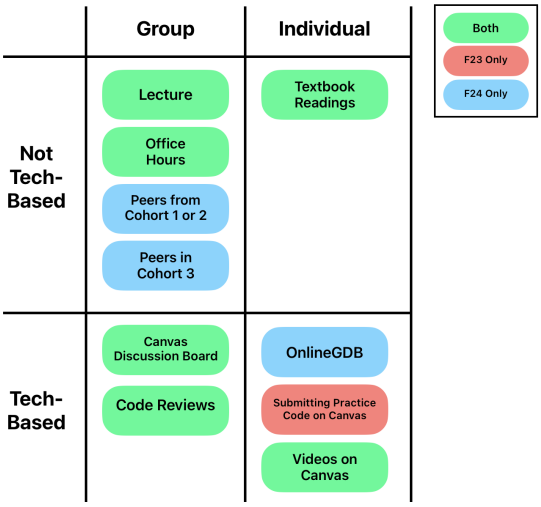


Figure 1: Resources available in the Fall 2023 and Fall 2024 iterations of the course, grouped by tech- vs. not tech-based

7 Data Collection and Analysis

7.1 Student Demographics

Both courses were conducted on the same yard at the same medium-maximum security male prison in the United States. Students self-reported their age group and self-identified race or ethnicity in both courses using identically presented multiple choice and select all questions in the first weekly reflection assignment (see Section 7.2). We did not collect data on gender expression in course reflection assignments, and therefore this dimension of students' identity is not captured in this paper (more reflection on this is included in Section 9.4). Lastly, previous research shows that learning disabilities are both highly represented and underdiagnosed among incarcerated adults [21]. In an effort to make accommodations for students regardless of whether they had diagnosed conditions, we included an open-ended question on the first weekly reflection assignment and followed up with students individually as needed. However, we did not include this as a variable in our analysis for this paper.

In Fall 2024, 27 of the 28 students (96.4%) submitted the first weekly reflection assignment, and all who submitted it responded to both demographic questions. The age breakdown was as follows: 7 students (25.9%) between ages 30-39, 14 students (51.9%) ages 40-49, 3 students (11.1%) ages 50-59, and 3 students (11.1%) age 60 or older. When self-reporting their race or ethnicity (selecting all listed options that applied), 10 students (37.0%) selected African American or Black, 5 (18.5%) selected White or Caucasian, 3 (11.1%) selected Asian or Asian American, 3 (11.1%) selected Chicanx or Latinx, 1 (3.7%) selected Native Hawaiian or Pacific Islander, 2 (7.4%) wrote in *Other: Mexican*, 1 (3.7%) wrote in *Other: Mexican American*, 1 (3.7%) wrote in *Other: Italian*, 1 (3.7%) wrote in *Other: Panama*, and 2 (7.4%) selected *Prefer not to say*.

All 20 students in the course (100%) responded to both demographics questions. The age demographics were similar to those reported in Fall 2024, in that the largest age group was 40–49, and no students were below age 30: 3 students (15.0%) were 30–39, 9 (45%) were 40–49, 5 (25%) were 50–59, and 3 (15%) were 60 or older. Self-reported race and ethnicities differed mainly in a higher representation of students selecting Chicanx or Latinx, and representation of students selecting American Indian or Alaska Native: 6 students (30%) selected African American or Black, 6 (30%) selected White or Caucasian, 6 (30%) selected Chicanx or Latinx, 3 (15%) selected American Indian or Alaska Native, 1 (5%) selected Asian or Asian American, 1 (5%) student wrote in *Other: African*, 1 wrote in *Other: Mexican American*, 1 wrote in *Other: Cuban American*, and 1 wrote in *Other: Mexican*.

7.2 Data Collection

In both courses, there were weekly reflection assignments that were graded for completion and counted for a small percentage of the final course grade. After the course, all course data including

reflection assignments were transcribed and had all personal identifying information removed by a third party in accordance with our protocol approved by our Institutional Review Board as not human subjects research (protocol #806658).

While some questions remained the same in both courses, the reflection assignments were adapted or changed to address various challenges as they arose (e.g., in Fall 2024 students provided open-ended feedback requesting adaptations to course discussion board procedures, and the subsequent reflection asked for specific recommendations to guide adaptation). Demographic questions regarding age, comfort with technology, devices used regularly before incarceration, and self-identified race/ethnicity were identical on the first weekly reflection assignment for both course offerings.

In addition to this demographic information, in this paper we examine reflection questions specifically related to learning resources. In both courses, we included a multiple choice grid question at four different points in the course: the second week, third week, week following the midterm (Week 6 in Fall 2023, Week 5 in Fall 2024), and towards the end of the course (Week 10 in Fall 2023, Week 8 in Fall 2024). In Fall 2023, these questions began with the phrase *How much did you use the following materials in studying for the Midterm Exam?* at the mid-point of the course and *How much do you feel that each of the following contributed to your learning so far?* at the other three time points. For each resource listed, students chose between six options: *N/A* or a five-point Likert-scale with one being least. In Fall 2024, the questions were phrased identically to Fall 2023, but the choices were simplified to three options: *I did not use this resource*, *I used it, but it was not helpful*, and *I used it, and it was helpful.*

7.3 Analysis Methods

Our methods used for data analysis to address each of our three research questions are as follows:

RQ1. To address our first research question, we computed descriptive statistics for the percentage of students in each age group who reported each of four options to describe their comfort-level with technology at the beginning of the course. We additionally compare these results across the two iterations of the course.

RQ2. To investigate how IA students value technology-based resources compared to other resources in CS1, we computed descriptive statistics for a) the percentage of Fall 2024 students who rated each resource as helpful, not helpful, and unused, and b) Fall 2023 how students rated each resource on a five point Likert-scale. We aggregated these percentages across the three time-points with identical phrasing (two at the beginning of the term, and one at the end of the term), with the exception of Code Reviews in Fall 2024: since confiscation of student laptops delayed the first Code Review assignment, students had not completed any before the first time-point and so it was not included on that reflection. Thus, in this instance, the percentages were calculated as an average of the second time-point and last time-point.

RQ3. To address our third research question, we dis-aggregate the ratings of usefulness by age and comfort-level with technology. For each age group or reported comfort-level, we computed the average percentage of responses in each rating group for technology-based and not technology-based resources. Our categorization of resources into technology- or not technology-based categories is visualized in Figure 1 and described in Section 6.

	Fall 2024				Fall 2023			
	T1	T2	T3	T4	T1	T2	T3	T4
Lecture	27	25	24	21	20	20	18	19
Office Hours	27	24	25	21	20	19	18	19
Peers in Cohort 3	27	25	23	21				
Peers from Cohort 1 or 2	27	23	24	21				
Discussion Board	27	25	25	21	20	20	18	19
Code Reviews		24	23	20	20	20	18	19
Textbook	27	24	23	21	20	20	18	19
Onlinegdb/Submit Code	27	24	25	21	19	20	18	19
Videos	26	24	24	21				

Table 1: Number of responses at each timepoint in Fall 2024 and Fall 2023 to question on each type of resource

8 Results

8.1 RQ1: Age and Comfort Level with Technology

As shown in Figure 2, notable patterns emerged from our analysis of reported comfort levels with technology overall by age group despite small sample sizes. The majority of students across all age groups in both years reported either the highest or second highest comfort level with technology among four given options. In the youngest age group, 30-39, all students across both Fall 2023 and Fall 2024 (n=3 and n=7, respectively) reported one of these two highest levels. At least one student in all of the other age groups—40–49, 50–59, and 60 or older—reported at least one of the two lower comfort levels except for the three students who were 60 or older in Fall 2023. This includes four total students who reported the lowest level, struggling with doing basic tasks: one 40–49 year old student in Fall 2023 (representing 11.1% of the n=9 40–49 year old students that year), one student 50–59 in both Fall 2023 (20% of n=5) and Fall 2024 (33.3% of n=3), and one student 60 or older in Fall 2024 (33.3% of n=3). We do not observe any clear pattern of difference between the two years, as students ages 30–39, 50–59, and 60 or older reported higher comfort with technology in 2023 than their counterparts in 2024, yet students age 40–49 (the largest age group in both years) in 2024 reported higher comfort levels than those in 2023.

8.2 RQ2: How IA Students Value Technology-Based Resources

As reported in Table 2 and visualized in Figure 3, the majority of students in both Fall 2024 and Fall 2023 reported some level of usefulness for all resources listed (as indicated by those who did not select *I did not use this resource* or *N/A*, respectively) except for peers from previous cohorts. In Fall 2024, all of the resources had less than 25% of the students report that they did not use it except for this one: 69.5% of students on average reported that they did not use as a resource peers from previous cohorts (students who had taken the same course 1-2 years prior). However, only 15.29%

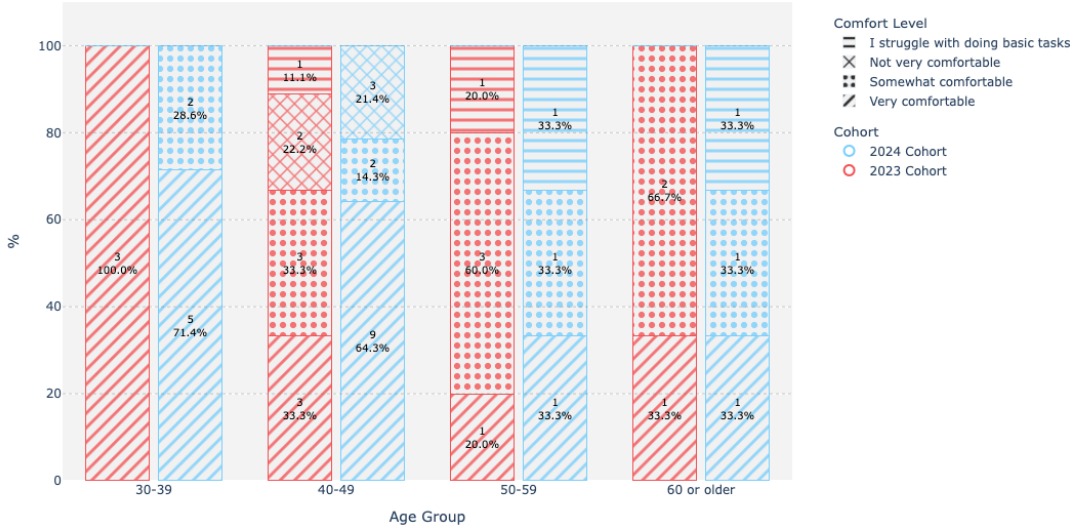


Figure 2: Percentage of students in each age group who reported each level of comfort with technology

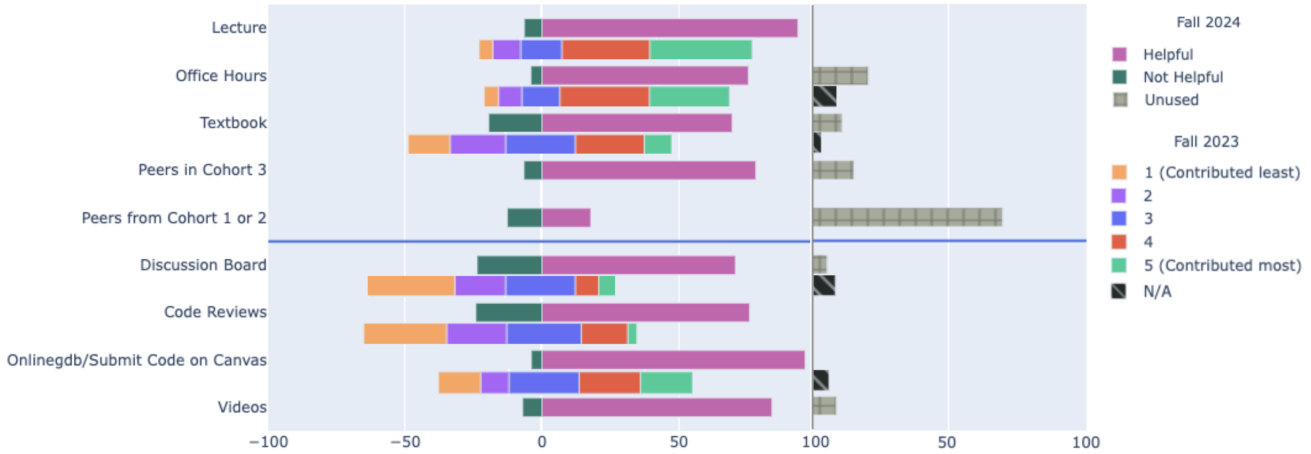


Figure 3: For each resource, the bars for Fall 2024 and Fall 2023 show the percentage of students who responded in each category regarding usefulness, grouped by tech-based (below horizontal line) or not tech-based (above horizontal line).

		Fall 2024			Fall 2023					
		Helpful	Not Helpful	Unused	5 (Most)	4	3	2	1 (Least)	N/A
Not Tech	Lecture	93.53%	6.47%	0.00%	37.46%	32.19%	15.18%	10.18%	5.00%	0.00%
	Office Hours	75.44%	4.01%	20.55%	29.21%	32.81%	14.04%	8.51%	5.26%	10.17%
	Textbook	69.49%	19.47%	11.04%	10.09%	25.18%	25.61%	20.35%	15.35%	3.42%
	Peers in Cohort 3	78.14%	6.57%	15.29%						
	Peers from Cohort 1 or 2	17.83%	12.67%	69.50%						
Tech	Discussion Board	70.66%	23.70%	5.64%	6.67%	8.51%	25.61%	18.60%	32.19%	8.42%
	Code Reviews	75.84%	24.16%	0.00%	3.33%	17.02%	27.37%	21.93%	30.35%	0.00%
	Onlinegdb/Practice Code	96.14%	3.86%	0.00%	19.03%	22.46%	25.79%	10.35%	15.44%	6.93%
	Videos	84.03%	7.04%	8.93%						

Table 2: Average percentage of students responding in each category of usefulness across three timepoints

of Fall 2024 students reported not using peers from within their own cohort as a resource, and 78.14% reported that they were a helpful resource.

The resource that the highest percentage of students on average reported using and being helpful in Fall 2024 was Onlinegdb, the code interpreter that was newly available to this cohort of students, with 96.14%. In addition, this is one of three resources for which 0% of students in Fall 2024 reported not using, in addition to Lecture and Code Reviews. Of these three, Onlinegdb was the only one that was truly optional: completing a minimum number of Code Reviews was required as a graded assignment, and there were often quizzes conducted in lecture that required student attendance. Thus, it makes sense that Code Reviews and Lecture were the two resources in Fall 2023 for which 0% of students responded *N/A*. However, Fall 2023 students' valuing of their adapted resource for running code, uploading drafts of their code to Canvas for the instructor to run, was more mixed with 6.93% of students responding *N/A* to indicate that they did not use it at all.

The resource in Fall 2023 that the most students reported contributed most to their learning was Lecture (37.46% on average rated it *5 (Contributed most)*), which was also a close second to Onlinegdb in Fall 2024 with 93.53% rating it as used and helpful. This was followed up in 2023 with Office Hours (29.21% said it contributed *most*)—the only other resource involving in-person instruction from the professor.

Other technology-based resources besides the respective methods of running code—Canvas Discussion Board, Code Reviews, and supplemental Videos uploaded to Canvas (F24 only)—were rated as used and helpful by most students in Fall 2024, but few students in Fall 2023 reported that they contributed highly to their learning compared to other resources. Discussion Board and Code Reviews were the categories with the two highest percentages of students rating them as used and not helpful in Fall 2024 (23.7% and 24.16%, respectively), and the highest percentages of students reporting that they contributed least to their learning relative to other resources in Fall 2023 (32.19% and 30.35%, respectively).

8.3 RQ3: Differences by Age

Results of our RQ3 analysis on the differences in how students rated technology-based versus not technology-based resources across different age groups are shown in Table 3 (Fall 2023) and Table 4, and visualized side by side in Figure 4.

In Fall 2023, the three students in the oldest age group (60 or older) more often rated Technology-Based as having contributed most to their learning compared to other resources than all other age groups. Notably, *no* students from this category ever rated any of the three Technology-Based resources *2, 1,* or *N/A* at any of the three time-points included in the average, resulting in a combined 0% on average for all three of these possible responses. That being said, students from this oldest age group tended to rate all resources as contributing highly to their learning, and reported Not Tech-Based resources even more highly than Tech-Based. This pattern continued with the other age groups in Fall 2023 as well, with these age groups all rating Not Tech-Based resources as having contributed most to their learning substantially more often than they reported this response for Tech-Based resources.

In 2024, this pattern reversed: students across all age groups more often reported Technology-Based resources as used and helpful than Not Technology-Based resources. This difference was the greatest for students in the middle age groups—40–49 and 50–59—and least substantial for students 60 or older. However, students in the oldest age group most often reported that they used Technology-Based resources and they were *not* helpful (29.17% on average), and reported them as helpful less often than the other age groups in Fall 2024. Students 60 or older also most often reported Not Technology-Based resources as used and not helpful (15.55%), but this was nearly half as often as they did for technology-based resources.

9 Discussion

9.1 Students from Various Age Groups Reported Low Comfort with Technology

Given prior work showing that increased age was correlated with worse attitudes toward learning programming, and a wealth of literature outside CS education on older adults' resistance to technology in general, it was unsurprising to find that students in the youngest age group among our incarcerated students (30–39) reported high levels of comfort with technology (although two students in this age group in Fall 2024 reported being only *Somewhat comfortable* as opposed to *Very comfortable*) [3, 9]. However, aside from this youngest age group, individuals from all other age groups—40–49, 50–59, and 60+ —reported the lowest comfort level: *I struggle with doing basic tasks on technology devices*, and 40–49 was the only age group with students reporting the second lowest comfort level *Not very comfortable*. Despite these differences, we note that the majority of individuals in all age groups across both years reported one of the two higher comfort levels with technology. Therefore, important takeaways we see for future work on CS education in prisons, and growing work on adult learners in CS more broadly, are: a) IA students in CS may benefit from additional resources on basic technology in order to utilize technology-based resources, b) we can not assume that only individuals from older age groups need these resources, and c) we also can not assume that all older students need these resources. In future work, we recommend exploring approaches to offering optional additional resources or training workshops on basic technology tasks ahead of classes starting if possible in order to make CS and other courses more accessible.

9.2 Peers Within Cohort Valued Highly as a Resource

We included peers in listed resources for the second iteration of the course in Fall 2024, which came about from our increasing awareness of the criticality of peers as a resource in prison learning environments. In a recent experience report on teaching CS1 in prison, Hogan et al. conducted a thematic coding analysis of students' views on collaboration. Takeaways included that incarcerated students may need to use peers as a resource due to limited other options for help. Additionally, in his phenomenographic study of students' perspectives on valuable educational experiences within HEP programs, Conway not only encouraged peer-based learning activities, but warned of the risks of not including them: as HEP

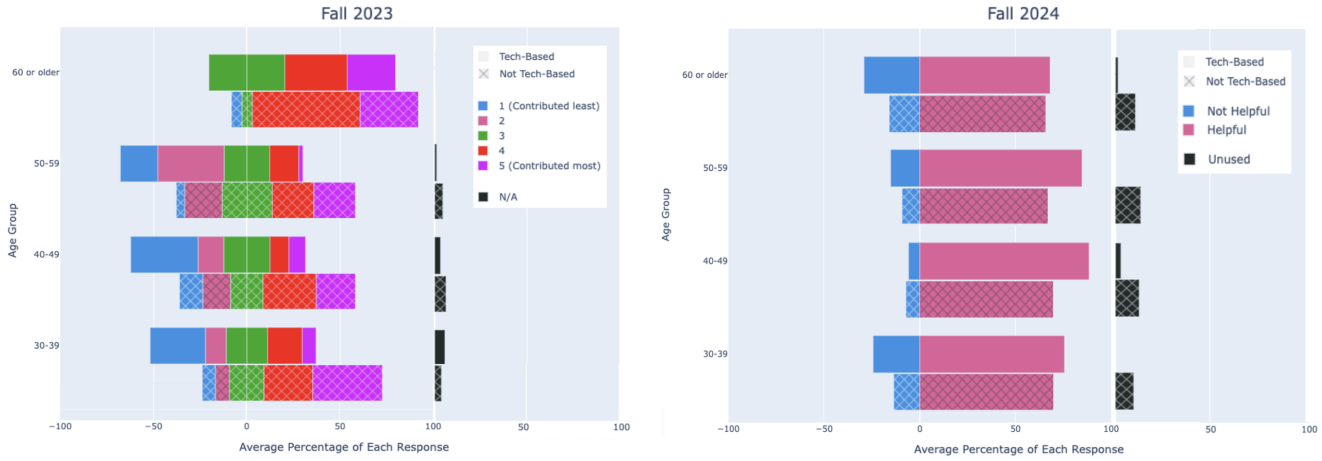


Figure 4: For each age group of students in Fall 2023 (left) and Fall 2024 (right), bars represent the average percentage of each possible response for all Tech-Based (no pattern) and Not Tech-Based (X pattern) resources

Fall 2023: Ratings of Tech-Based vs. Not Tech-Based Resources by Age Group								
Age Group	**n (%)**	**Resource Type**	**5 (Most)**	**4**	**3**	**2**	**1 (Least)**	**N/A**
30-39	3 (15.0%)	Tech-Based	7.41%	18.52%	22.22%	11.11%	29.63%	11.11%
		Not Tech-Based	37.04%	25.93%	18.52%	7.41%	7.41%	3.70%
40-49	9 (45.0%)	Tech-Based	8.95%	10.03%	24.84%	13.73%	36.11%	6.33%
		Not Tech-Based	20.98%	28.39%	17.28%	14.81%	12.35%	6.17%
50-59	5 (25.0%)	Tech-Based	2.22%	15.55%	24.44%	35.55%	20.00%	2.22%
		Not Tech-Based	22.22%	22.22%	26.67%	20.00%	4.45%	4.45%
60+	3 (15.0%)	Tech-Based	25.92%	33.33%	40.74%	0.00%	0.00%	0.00%
		Not Tech-Based	31.48%	57.41%	5.56%	0.00%	5.56%	0.00%

Table 3: The number and percentage of students in each age group for Fall 2023, and average ratings of Tech-Based and Not Tech-Based resources for each age group

Fall 2024: Ratings of Tech-Based vs. Not Tech-Based Resources by Age Group					
Age Group	**n (%)**	**Resource Type**	**Helpful**	**Not Helpful**	**Unused**
30-39	7 (25.9%)	Tech-Based	75.59%	24.41%	0.00%
		Not Tech-Based	67.62%	13.10%	19.29%
40-49	14 (51.9%)	Tech-Based	88.39%	5.93%	5.68%
		Not Tech-Based	67.95%	6.99%	25.05%
50-59	3 (11.1%)	Tech-Based	84.72%	15.28%	0.00%
		Not Tech-Based	64.44%	8.89%	26.67%
60+	3 (11.1%)	Tech-Based	68.05%	29.17%	2.78%
		Not Tech-Based	63.33%	15.55%	21.11%

Table 4: The number and percentage of students in each age group for Fall 2024, and average ratings of Tech-Based and Not Tech-Based resources for each age group

programs exist at the contradiction of "liberatory" and "transformational" learning within an environment of severe restriction and oppression, "not encouraging these types of educational practices may increase the likelihood of students experiencing stigmatization, as programs can become perceived as an additional form of social control" [12]. This connects as well to Castro and Brawn's published discussion between teacher and student in an HEP program on the potential and limitations of critical pedagogy in the prison environment, where it is pointed out that the lack of access to resources means that the perspectives available to students are often filtered through the instructors own perspective, limiting students' freedom to support opposing views [7].

Our results on the value of peers within students' own cohort as a resource support these prior findings, with 78.14% of students reporting that they used them as a resource and found it helpful. Interestingly, however, peers from other cohorts (who had taken the course 1-2 years prior) as a resource were an outlier among the resources we included: this resource was the most frequently reported unused by a significant margin relative to all other resources, and also the least reported helpful when it was used. This may indicate more importance given to the community aspect of peers as a resource, as opposed to simply having limited other options. We saw potential indications of this in surrounding open-ended feedback on the reflection assignments related to peer collaboration as a resource, as one student wrote: *"A sense of community helps me feel more confident."* In reviewing these additional insights from students, we also noted a pattern that two of the few students who reported not using peers within their cohort as a resource at the first time-point in Fall 2024 noted in their open-ended feedback plans of doing so in the future, with one writing: *"So far I have worked independently. Tonight I will seek peer help."*

9.3 When Available, Code Interpreters were Most Highly Valued Resource

One of the primary differences between the Fall 2023 and Fall 2024 iterations of the course was the availability of a web-based code interpreter, Onlinegdb, on students' personal laptop devices in Fall 2024. While we heard anecdotally from many students while teaching the course that they valued the code interpreter as a resource, our findings from this study help confirm the weight of this improvement from the students' perspective, as it was revealed to be the resource most often rated as used and helpful among all of the resource choices in Fall 2024. In addition, supplemental context offered by students in open-ended feedback on reflections showed that students not only credited the availability of this resource with their engagement in the subject, but also with making other resources more useful. One student wrote: *"Initially I despised this course and had to take 2 aspirin afterwards. Now I have to pull away from it because I was neglecting my other classes. I wake up in the morning thinking about code! The videos and lecture slides are great because I can go back and revisit any portion I need. Additionally, onlinegdb is a gamechanger. I would not be as enthusiastic if I were not able to see the product of my work firsthand, nor would the videos be as effective if I couldn't do the work alongside the videos."* As noted in our results, students in the oldest age group more often reported Technology-Based resources—including Onlinegdb—as used and not helpful compared to other age groups. Therefore, building on our recommendations in Section 9.1, this may indicate additional improvements needed in the future to make these resources more equally accessible for all students. However, the findings of this paper overall support growing calls to increase technology infrastructure available to incarcerated students [5, 18], with specific support of how the availability of a code interpreter positively impacts students' experiences in CS1.

9.4 Limitations and Future Work

One primary limitation of this work is that it is limited to one prison facility context. As noted in Section 7.1, we did not collect data on students' self-identified gender expression. Currently, regardless of self-identified gender, most incarcerated people are assigned to male or female prison facilities according to their assigned sex at birth [10]. Building on previous work that has shown nuances of justice-impacted women's experiences related to using technology, next steps for this work include focusing on the experiences of incarcerated students at women's facilities. Future work should also explore the specific experiences of transgender students and other students from minoritized gender identities in both types of facilities. In addition, future work is needed to address the specific needs of students with unique learning needs, who are also overrepresented in the incarcerated population. Planned next steps to address these issues are to expand studies to include multiple types of prison facilities, where student demographics will be more diverse and also more accurately represent a larger portion of the incarcerated student population.

10 Conclusion

The goal of this study was to explore how incarcerated adult (IA) students valued Technology-Based versus Not Technology-Based resources in a CS1 course taught in prison, and additionally examine how students' age was related to their comfort level with technology overall and their use of the different course resources. Data was collected in two iterations of a CS1 course taught in the same male prison in the U.S., one year apart, with 48 students total. In the first iteration of the course, students did not have access to a code interpreter, whereas students in the second iteration could run their own code—adding another layer of interest in IA students' use of Technology-Based resources. Major findings of this paper include:

- The code interpreter available in Fall 2024 was most highly rated resource in this course iteration, with 96.14% of students on average reporting they used it and it was helpful
- Lecture and Office Hours—the two resources including in-person instruction from the professor—were the most highly rated resources in Fall 2023, before students had direct access to a code interpreter
- No students in Fall 2024 reported that they did not use the code interpreter resource across any of the three time-points when data was collected on resource usefulness
- High ratings of the code interpreter in Fall 2024 were contrasted with mixed responses on the adapted method for Fall 2023 students to submit practice code via Canvas for the instructor to run daily, 6.93% of whom reported that this resource did not contribute at all to their learning

In addition, we have made specific recommendations in the Discussion section on next steps to guide the development of improved resources for CS courses offered in prisons, including the need for additional resources in the future to prepare IA students to leverage Technology-Based resources.

Acknowledgments

This work is supported by the Ford Foundation Predoctoral Fellowship and NSF Award #2315909.

References

[1] [n. d.]. GDB online Debugger | Compiler - Code, Compile, Run, Debug online C, C++. https://www.onlinegdb.com/

[2] [n. d.]. STEM Opportunities in Prison Settings (STEM-OPS). https://stemforall2020.videohall.com/presentations/1801

[3] Friday Joseph Agbo. 2024. Broadening Participation in Adult Education: A Literature Review of Computer Science Education. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1*. ACM, Portland OR USA, 11–17. https://doi.org/10.1145/3626252.3630797

[4] James R. Aman. 1990. Computer science in correctional education. In *Proceedings of the twenty-first SIGCSE technical symposium on Computer science education*. ACM, Washington D.C. USA, 147–151. https://doi.org/10.1145/323410.323436

[5] Eden M. Badertscher, Traci Beaucoudray, Rosie Butts, Chris Etienne, Laura Hardwick, Jessica Hicklin, Veronica Horowitz, Jason O'Malley, Michael A. Saine, Kevin P. Waterman, and Kevin Windhauser. 2024. *The Principles and Standards for Information & Communication Technology in Prison*. Technical Report. Education Development Center. 29 pages. https://stem-ops.org/tech-in-prison-settings/

[6] Erin L. Castro. 2024. Prison Education Is Dangerous. *New Directions for Higher Education* 2024, 208 (2024), 17–23. https://doi.org/10.1002/he.20515 _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1002/he.20515.

[7] Erin L. Castro and Michael Brawn. 2017. Critiquing Critical Pedagogies Inside the Prison Classroom: A Dialogue Between Student and Teacher. *Harvard Educational Review* 87, 1 (March 2017), 99–121. https://doi.org/10.17763/1943-5045-87.1.99

[8] Erin L. Castro, Caisa E. Royer, Stephanie Gaskill, and Estefanie Aguilar-Padilla. 2022. *"It's Useless, to Put it Politely": Experiences with Technology Among Incarcerated Students Receiving Second Chance Pell at Four Institutions*. Brief 9. Collaborative for Higher Education Research and Policy, The University of Utah. https://cherp.utah.edu/projects/pell_is_not_enough.php#publications-slide

[9] Polina Charters, Michael J. Lee, Amy J. Ko, and Dastyni Loksa. 2014. Challenging stereotypes and changing attitudes: the effect of a brief programming encounter on adults' attitudes toward programming. In *Proceedings of the 45th ACM technical symposium on Computer science education*. ACM, Atlanta Georgia USA, 653–658. https://doi.org/10.1145/2538862.2538938

[10] Kelsie Chesnut and Jennifer Peirce. 2024. Advancing Transgender Justice: Illuminating Trans Lives Behind and Beyond Bars. *Vera Institute of Justice* (Feb. 2024).

[11] Patrick Filipe Conway. 2022. Andragogy in Prison: Higher Education in Prison and the Tenets of Adult Education. *Adult Education Quarterly* 72, 4 (Nov. 2022), 361–379. https://doi.org/10.1177/07417136221100481 Publisher: SAGE Publications Inc.

[12] Patrick Filipe Conway. 2024. 'Education changes a person': exploring student development in a college-in-prison program through critical andragogy. *Teaching in Higher Education* 29, 8 (Nov. 2024), 2008–2024. https://doi.org/10.1080/13562517.2023.2172568

[13] Ben Van Dusen and Jayson Nissen. 2021. Tenets of QuantCrit. https://doi.org/10.48550/arXiv.2110.12871 arXiv:2110.12871 [physics].

[14] Helen Farley, Angela Murphy, and Tasman Bedford. 2012. Bridging the digital divide: Bringing e-literacy skills to incarcerated students. *ASCILITE Publications* (Nov. 2012), 307–311. https://doi.org/10.14742/apubs.2012.1647

[15] Nichole M. Garcia, Nancy López, and Verónica N. Vélez. 2018. QuantCrit: rectifying quantitative methods through critical race theory. *Race Ethnicity and Education* 21, 2 (March 2018), 149–157. https://doi.org/10.1080/13613324.2017.1377675

[16] Emma Hogan, John Driscoll, Adalbert Gerald Soosai Raj, William Griswold, and Leo Porter. 2024. Uncovering Meaningful Computing Contexts for Incarcerated College Students. In *Proceedings of the 2024 on Innovation and Technology in Computer Science Education V. 1*. ACM, Milan Italy, 701–707. https://doi.org/10.1145/3649217.3653632

[17] Emma Hogan, Ruoxuan Li, Adalbert Gerald Soosai Raj, William G. Griswold, and Leo Porter. 2024. Challenges and Approaches to Teaching CS1 in Prison. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1*. ACM, Portland OR USA, 512–518. https://doi.org/10.1145/3626252.3630802

[18] Emma Hogan, Darakhshan Mir, Andrew Cencini, Keith O'Hara, Adalbert Gerald Soosai Raj, William Griswold, and Leo Porter. 2024. Re-Instatement of Pell Grants for Incarcerated Students: Implications for CS Education. In *Proceedings of the 2024 on RESPECT Annual Conference*. ACM, Atlanta GA USA, 122–127. https://doi.org/10.1145/3653666.3656099

[19] Aleata Hubbard Cheuoua. 2021. Confronting Inequities in Computer Science Education: A Case for Critical Theory. In *Proceedings of the 52nd ACM Technical Symposium on Computer Science Education*. ACM, Virtual Event USA, 425–430. https://doi.org/10.1145/3408877.3432453

[20] Malcolm S. Knowles. 1978. Andragogy: Adult Learning Theory in Perspective. *Community College Review* 5, 3 (Jan. 1978), 9–20. https://doi.org/10.1177/009155217800500302 Publisher: SAGE Publications Inc.

[21] Angela Koo. 2015. Correctional Education Can Make a Greater Impact on Recidivism by Supporting Adult Inmates with Learning Disabilities. *Journal of Criminal Law and Criminology* 105, 1 (2015), 39. https://scholarlycommons.law.northwestern.edu/jclc/vol105/iss1/6

[22] H. Richard Milner IV, Jacob S. Bennett, Stanley Andrisse, Eden Badertscher, Dena Lane-Bonds, Ira Murray, Basia Skudrzyk, Jill F. Stockwell, and Syrita Steib. 2024. Addressing Opportunity Gaps in Higher Education in Prison Programs. *The New Educator* 20, 3-4 (Oct. 2024), 148–163. https://doi.org/10.1080/1547688X.2024.2416735 Publisher: Routledge _eprint: https://doi.org/10.1080/1547688X.2024.2416735.

[23] Brian Nam-Sonenstein and Nell Haney. 2025. *Bad Behavior: How prison disciplinary policies manufacture misconduct*. Technical Report. Prison Policy Initiative. https://www.prisonpolicy.org/reports/discipline.html

[24] Martin Nisser, Marisa Gaetz, Andrew Fishberg, Raechel Soicher, Faraz Faruqi, and Joshua Long. 2024. From Prisons to Programming: Fostering Self-Efficacy via Virtual Web Design Curricula in Prisons and Jails. In *Proceedings of the CHI Conference on Human Factors in Computing Systems*. ACM, Honolulu HI USA, 13. https://doi.org/10.1145/3613904.3642717 arXiv:2404.15904 [cs].

[25] Stephen Raher. 2020. The Company Store and the Literally Captive Market: Consumer Law in Prisons and Jails. *Hastings Race and Poverty Law Journal* 17, 1 (2020), 3–86. https://heinonline.org/HOL/P?h=hein.journals/hasrapo17&i=3

[26] Ralf St. Clair. 2024. Andragogy: Past and Present Potential. *New Directions for Adult and Continuing Education* 2024, 184 (2024), 7–13. https://doi.org/10.1002/ace.20546 _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1002/ace.20546.

[27] Niloufer Taber, Amanda Nowak, Maurice Smith, Jennifer Yang, and Celia Strumph. 2024. The First Year of Pell Restoration. *Vera Institute of Justice* (June 2024).

[28] Kurtis Tanaka and Danielle Cooper. 2020. *Advancing Technological Equity for Incarcerated College Students: Examining the Opportunities and Risks*. Technical Report. Ithaka S+R. https://doi.org/10.18665/sr.313202