Students' Evaluation of a Free and a Paid Interactive eTextbook for Computing Education

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Abstract

The rising cost of learning resources creates obstacles to accessibility in higher education, particularly for students pursuing Computer Science. With the increasing availability and quality of open educational resources (OER), they have gained popularity as potential replacements for traditional paid materials. This study evaluates the effectiveness of an OER interactive textbook (eTextbook) and a paid eTextbook used in undergraduate computing courses. It focuses on students' perceived educational value of each, aiming to provide educators with insights that support informed decisions about course resources. We surveyed undergraduate students at a research-intensive US university who had taken an *'Intro to Programming'* course with a free eTextbook and an *'Intro to Data Structures'* course with a paid eTextbook to compare their effectiveness by asking students to rate the textbooks independent of the course difficulty. The collected data was analyzed to evaluate the comparative impact of free and paid eTextbooks. Our findings suggest that the OER eTextbook examined in this study can offer educational value comparable to or greater than the paid alternative. While the paid eTextbook was seen as more polished, students appreciated the free eTextbook's interactivity and course-specific customization, highlighting the importance of utility and engagement in learning resources. Although limited to the textbooks studied, our findings highlight the potential for OER to serve as a viable option in undergraduate computing courses. This insight may encourage instructors to consider OER as a cost-effective alternative that enhances accessibility without compromising educational quality.

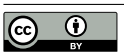
CCS Concepts

• **Applied computing** → **Interactive learning environments**.

Keywords

OER, Open Educational Resources, eTextbook, Higher education, Interactive Learning, Intro to Programming, Students' Evaluation

* Both authors contributed equally to this work.



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1 Introduction

The cost of educational resources poses a barrier to accessibility in higher education, particularly for students pursuing Computer Science, a field that is heavily interactive and requires specialized tools, such as programming environments and interactive learning platforms. Interactive electronic books, which in this paper we will refer to as 'eTextbooks', are particularly relevant in CS education due to their features such as programming visualizations, code challenges, and reading questions, which are merged with the readings and can enhance student learning. Although, eTextbooks tend to be more affordable than printed textbooks, our study shows that *paid eTextbooks still pose a financial burden for students, especially when they are required for homework assignments.* In these cases, both the cost and quality of the eTextbook become central to students' learning experience.

To understand the effectiveness of free and paid eTextbook we ask the following research questions: 1) *What are students' perceptions of the quality of a required paid and free eTextbook in computing courses?* and 2) *To what extent does the perceived cost-effectiveness of a required paid and free eTextbook influence students' satisfaction with the eTextbook?* We surveyed 58 students who took *'Intro to Programming'* course with a free eTextbook and *'Intro to Data Structures'* course with a paid eTextbook in consecutive terms between 2022 and 2024. Both eTextbooks were required for their respective courses. By focusing on lower division intro courses, our study captures the perspectives of learners at the early stages of their computing education. We analyzed and categorized student responses by applying the values defined by the Expectancy-Value Theory (EVT): Attainment, Cost, and Utility [21].

Our study aims to highlight students' needs and values related to eTextbooks. Educators can use these findings to evaluate and choose resources (whether paid or free) that align with those values to improve educational experience of their students, especially if the eTextbook is a required component of the course.

Our paper focuses on one free eTextbook (green, rounded-corner shapes in the figures) and one paid eTextbook (orange, sharp-corner shapes in the figures). While the findings are not meant to generalize to all eTextbooks, they offer useful insight into how students perceive required eTextbooks in computing courses and what they value when using them.

2 Related Work

2.1 Textbook Cost as an Economic Barrier

In 2018, it was reported that 88% of 1,651 students perceived textbook costs to be nearly as stressful as tuition fees, causing 31% of these students to enroll in fewer classes, while 43% skipped meals to afford their required textbooks [1]. CollegeBoard reported that the annual student budget for books and supplies, including both physical textbooks and eTextbooks, was $1,470 at a public two-year institution and $1,250 at a four-year institution for the 2023-2024 academic year [11] . For the 2024-2025 academic year [12] , these costs increased to $1,520 and $1,290, respectively. This trend highlights the extent of the barriers caused by high textbook prices on students. The high cost of textbooks can also negatively affect their retention [20]. In 2024 3,447 faculty from across the US were surveyed, in which 72% of them required print textbooks and 28% required digital textbooks[17].

2.2 Importance of Interactive eTextbooks in CS

A digital textbook is essentially a scanned or copied version of a physical textbook, often available as a PDF or in a web browser. While it makes the content accessible on a device, it primarily retains the format of the original textbook, with some enhancements like hyperlinks [2, 7, 15, 16, 18] and interactive visuals.

On the other hand, eTextbooks are standalone resources which offer an interactive experience by incorporating multimedia features such as videos and quizzes. In regards to computer science, there exists a term for interactive eTextbooks, known as icseBook (Interactive Computer Science Electronic Books) [9]. An icseBook must contain a subset of the following features: interactive visualizations, automatic feedback from exercises, CS-specific features (e.g., algorithm visuals, programming visuals, and code challenges), and the ability for instructors to reorder sections [9][10]. IcseBooks highlight the significance of embedded interactive features that enable students to practice coding and test their knowledge, among other advantages that directly support active learning. IcseBooks emphasize the convenience of utilizing the technology that students are likely already using for their programming classes. By integrating programming visualization [3, 19], icseBooks enhance the online experience; this feature allows students to observe how code is constructed and how algorithm visualizations progress [4].

2.3 Open Educational Resources (OER)

This leads us to OER which have emerged as a free alternative to traditional paid materials including eTextbooks. OERs are classified under Creative Commons license meaning students, educators, and anyone who has access to the web can reuse, retain, revise, remix, and redistribute OERs [5, 22]. This open model not only reduces financial barriers but also promotes collaboration and innovation across educational institutions. Despite the widespread of new OERs, adoption among faculty remains limited. According to the study, [17] more than 56% of faculty do not use OERs, underscoring the need for greater awareness and evaluation of their effectiveness.

eTextbooks are digital, online textbooks. This digital nature allows for easier updates, interactive features, and better accessibility compared to traditional printed materials. OER eTextbooks have become increasingly popular, and cover broad range of topics from introductory computer science for novice learners [8], to college level parallel computing [13].

2.4 Rate of Gain (Information Foraging Theory)

Information Foraging Theory models how individuals make decisions about where to allocate their attention and effort based on the concept of rate of gain - the amount of useful information acquired per unit of cost (time, effort, or money) [14]. Under this framework, students seek to maximize the value they gain from a resource relative to what it costs them to access or use it. When applied to textbooks, this means students assess not just the quality of the material, but how that quality compares to the financial and cognitive costs involved. A paid textbook may offer high-quality content, but if a free alternative provides similar value at a lower cost, the free option offers a higher rate of gain.

3 Method

Category	Response	#	%
Programming Experience	Yes	29	50.0%
	No	25	43.1%
	Other	4	6.9%
Native English Speaker	Yes	45	77.6%
	No	13	22.4%
Year in College	1st Year	8	13.8%
	2nd Year	32	55.2%
	3rd Year	14	24.1%
	4th Year	4	6.9%
Gender Identity	Man	34	58.6%
	Woman	22	37.9%
	Other	2	3.4%
Race	African American or Black	3	5.2%
	Asian or Asian American	42	72.4%
	Chicanx or Latinx	9	15.5%
	White or Caucasian	10	17.2%
	Prefer not to respond	1	1.7%

Table 1: Participant Demographics (N = 58)

3.1 Study Context and Participant Recruitment

This study examines students' perceptions of two eTextbooks used in two lower division computing courses: a free textbook developed by the faculty and teaching assistants in Computer Science and Engineering Department in University of California San Diego for the *'Intro to Programming'* course using the Stepik platform[1] and a paid textbook used in *'Intro to Data Structures'*.

These courses are consecutive in the department's required sequence, and all participants in our sample had completed both of the courses. Our sample was drawn from two cohorts, meaning we included students who had completed the courses in two different academic years (2022-2024). Across the two cohorts included in

[1] https://stepik.org/84164

Research Question (RQ)	**Survey Question** (Q) ✻: Not Required **MC:** Multiple Choice **FR:** Free Response	
RQ1: What are students' perceptions of the **quality** of a required paid and free eTextbook in computing courses?	Q1/Q9: Overall, how would you rate the quality of **Paid**_eTextbook / **Free**_eTextbook?	MC
	Q17: Assume cost is not a factor. Which of the textbooks would you prefer?	MC
	↳ Q18: ✻Please explain why	FR
RQ2: To what extent does the perceived **cost-effectiveness** of a required paid and free eTextbook influence students' satisfaction with the eTextbook?	Q7: In your opinion, is the cost of **Paid**_eTextbook justified? Why or why not?	FR
	Q15: **Free**_eTextbook was a free textbook. What are your thoughts on the quality of the free **Free**_eTextbook?	FR

Figure 1: Survey Questions Used for the Research Questions

our analysis, the structure of each course remained highly consistent. Each offering included programming assignments, mandatory eTextbook readings, and assessments. While instructional variations (e.g., different instructors or updates to assignments) occurred, the overall learning objectives and policies regarding textbook use, grading, and expectations for how students engaged with the material did not change.

Our primary objective was to compare the perceived value of eTextbooks used in these courses. To collect student opinions, we designed a survey that included questions about their perceptions of each textbook and additional questions prompting direct comparisons of the two textbooks. The full survey with 28 questions can be found here: **https://bit.ly/eTextbSurvey**. To ensure participants had experience with both books, we compiled a list of undergraduate students who had taken both courses. We recruited participants by sending an email invitation to approximately 550 eligible students. The survey was estimated to take 10 minutes to complete, and participants were entered into a raffle for $10 gift cards as an incentive. We received 58 responses which form the basis of our analysis. Participant demographics are shown in Table 1.

3.2 Survey Analysis

We centered our analysis on the survey questions presented in Figure 1, as this subset offered the clearest insights into student attitudes toward the textbooks and had direct relevance to our research questions. The question identifiers "Q#" in the figure are also used throughout the Results section. For example, "(Q9)" refers to survey question 9. While we reviewed additional survey items to provide broader qualitative context, the subset in Figure 1 offered the clearest insights into student attitudes toward the textbooks.

RQ1: Perceived Quality of Textbooks. To evaluate how students perceived the quality of each textbook, we asked them to respond to the following questions: *"Overall, how would you rate the quality of the free textbook?"* and *"Overall, how would you rate the quality of the paid textbook?"* Responses were recorded on a 5-point Likert scale (from "Poor" = 1 to "Excellent" = 5). We then compared the two distributions using the Mann-Whitney U test.

RQ2: Preference Between Textbooks. To determine which textbook students preferred without considering the cost, we asked: *"Assume cost is not a factor. Which of the following textbooks would you prefer?"* We analyzed the distribution of responses using a Chi-squared test. Respondents could optionally explain their choice in a free-response field: *"Please explain your answer to the question above."* More than two-thirds of participants responded to the free-response prompt.

Two researchers independently coded the responses into 14 inductively developed categories, which were later consolidated. Before coding, they jointly created an initial codebook by reviewing sample responses and defining each category. After coding separately, they met to resolve any disagreements through discussion. When discrepancies revealed unclear or overlapping categories, they refined the codebook (e.g., renaming, merging, or adding codes) and re-coded all responses to ensure consistency. Because the process emphasized consensus and iterative refinement rather than statistical agreement, formal inter-rater reliability measures were not calculated. Consistency was ensured through repeated discussion and validation of the shared coding framework. The same disagreement-resolution process was used for the other open-ended questions. Consolidated categories were visualized in a dumbbell chart (Figure 5) to compare which aspects students preferred in each book and identify the features driving their preferences.

RQ2: Perceptions of Cost-effectiveness of Textbooks. To evaluate students' opinions on the cost-effectiveness (defined as the ratio of perceived value to cost) of the paid and free textbooks, we asked the following open-ended questions: *"In your opinion, is the cost of the paid textbook justified? Why or why not?"* and *"[Name] was a free textbook. What are your thoughts on the quality of the free textbook?"* For the paid textbook question, two researchers independently categorized each response as either "yes, justified" or "no, unjustified." Ambiguous responses (10.3%) were excluded from the analysis. The remaining responses were analyzed using a Chi-squared test. For both questions, we also conducted a qualitative thematic analysis. Two researchers independently tagged responses using inductively developed codes, resulting in 14 categories for the paid and 17 for the free textbook. These categories were grouped under broader themes of positive or negative sentiment. Final frequencies were visualized using Mekko charts (Figures 7a and 7b).

Motivation: Financial Impact of Textbook Costs. To assess how textbook costs affect students financially, we asked: *"Considering your socio-economic status, does the cost of textbooks play a significant role in your finances?"* This question aimed to explore the financial burden of textbooks and the potential benefits of OER as a way to alleviate that burden. We also examined responses to the question, *"How would you describe your socio-economic status?"* to understand how students' self-identified backgrounds intersect with their reported financial impact of textbook costs.

4 Results

This section presents the findings from our analysis of student perceptions regarding free and paid interactive eTextbooks. We examine two perspectives: first, the perceived quality of the textbooks, independent of cost of use; second, cost-effectiveness of the textbooks, which considers both the quality and the cost of using the resource.

Analyzing responses to the earlier socio-economic and cost-impact questions, the overall trend reinforces the motivation outlined in our introduction: textbook cost is a meaningful financial burden for many students. This perception provides important context for interpreting student preferences and underscores the

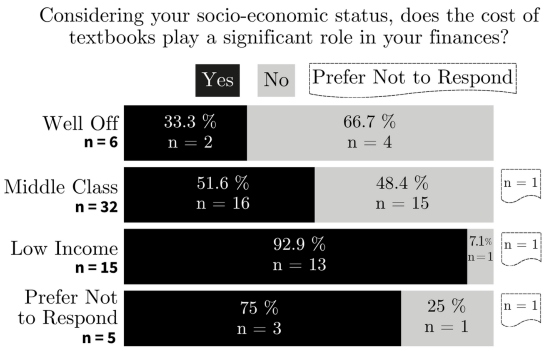


Figure 2: *Student responses for whether the cost of textbooks is a significant financial factor depending on their socio-economic status*

relevance of examining cost-effectiveness while selecting educational resources. Figure 2 shows the students responses to whether the cost of textbooks play a significant financial factor depending on their socio-economic status. Students across the three socioeconomic classes have shared how significant textbook cost is. This highlights how a required paid resource impacts a broader range of students than typically assumed.

4.1 RQ1: Perceived Quality of Free & Paid eTextbooks

We analyzed student responses on the quality of the free and paid textbooks (Q1 & Q9). Results are shown in Figure 3. Student responses were collected on a Likert scale. Both textbooks received a median rating of 4.0. The mean rating for the paid textbook was 3.88, while the free textbook received a mean rating of 3.78. The Mann-Whitney U test revealed no statistically significant difference between the two distributions, suggesting that students generally perceive the quality of both textbooks similarly. Additionally, students' textbook preferences were evaluated using their responses to the cost-neutral question (Q17), which was designed to isolate perceptions of quality - defined here as the overall value provided by the textbook, including content, usability, and educational effectiveness.

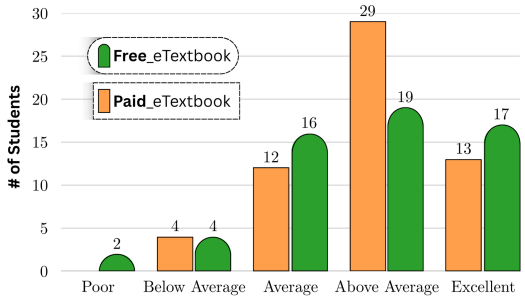


Figure 3: Quality of eTextbooks

By explicitly asking students to disregard cost we hoped to remove the cost dimension from consideration. This allowed us to focus on students' evaluations purely based on the intrinsic quality of the materials. After excluding "no preference" responses (8.6%), we observed a slight preference for the free eTextbook. However, a Chi-squared test revealed no statistically significant difference between the two distributions (Figure 4), reinforcing the earlier finding that students perceive the quality of both textbooks similarly. To better understand the reasoning behind these preferences, we analyzed the open-ended responses accompanying this question. Figure 5 shows the reasoning students provided for preferring one eTextbook over the other. The graph shows how often students mentioned each EVT value of eTextbooks when explaining why they preferred the free or paid option. The x-axis is the frequency with which that value was mentioned within each group of students, and the y-axis lists the values themselves. Within this framework, Utility provides the most comparable insights since Cost is only applicable to the free eTextbook and Attainment includes features that, although appreciated by students for helping them connect with their role in computer science, are not shared across both books (only one of the three features appears in both).

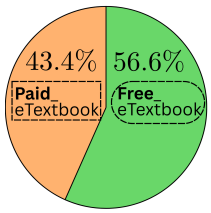


Figure 4: Textbook Preference When Cost is Not a Factor

Focusing on Utility, "Overall Better" and "Course Relevancy" have the closest percentage match between the two textbooks. As shown in the dumbbell chart (Figure 5), students who preferred the free eTextbook often cited its straightforward interface and ease of use, while those who preferred the paid eTextbook highlighted its visual aids and practice exercises. These responses provide insight into the specific features students value in learning materials and suggest potential directions for improvement, particularly in balancing interactivity with accessibility.

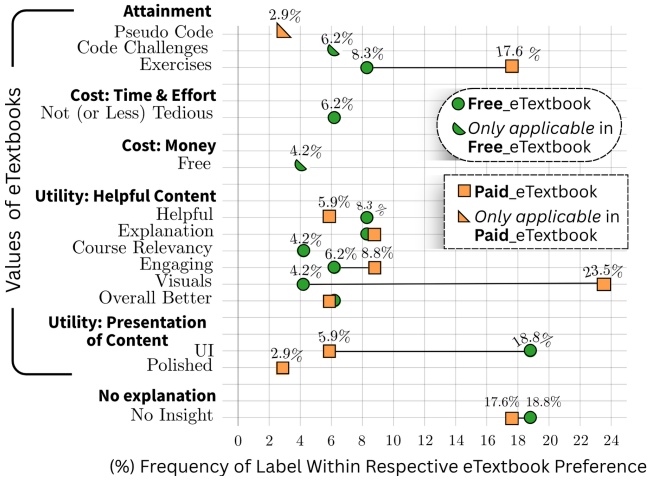


Figure 5: A comparison of student responses to *"Assume cost is not a factor. Which of the following textbook would you prefer and why?"*

4.2 RQ2: Perceived Cost-Effectiveness of Free & Paid eTextbooks

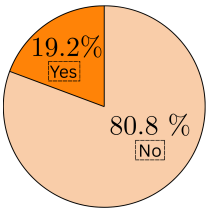
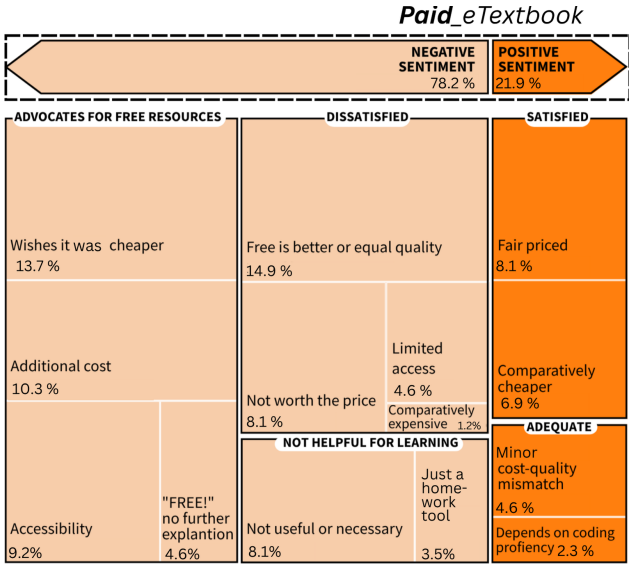


Figure 6: Distribution of responses on paid textbook cost justification

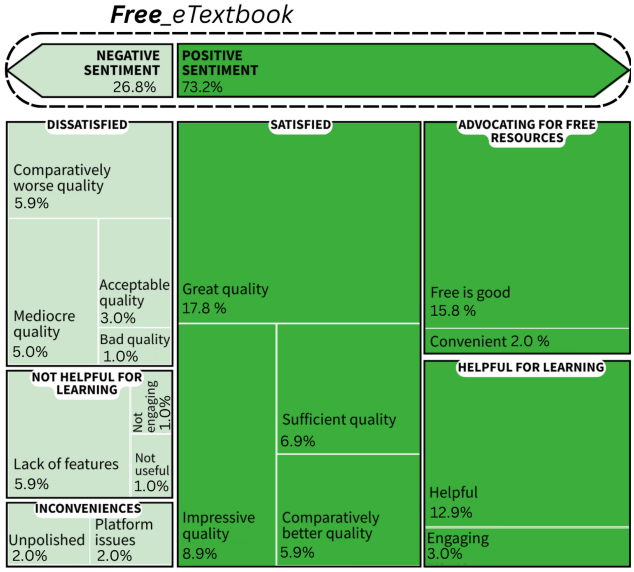
In addition to perceived quality, we examined students' perceptions of cost-effectiveness, defined as a combined assessment of a textbook's value relative to its cost. We first analyzed responses regarding the paid textbook (Q7), classifying them as either justified or unjustified. Ambiguous responses (10.3%) that could not be reliably interpreted were excluded - for example, responses such as "It did help me but I feel like there are possibly better options" or "Somewhat, but I am stingy and broke." A Chi-squared test revealed a statistically significant difference in the distribution of classified responses, indicating **that the majority of students did not believe the cost of the paid textbook was justified (Figure 6)**.

Responses were then categorized based on emergent themes, as shown in Figure 7a. This qualitative analysis revealed that negative sentiments, particularly around cost, were the most prevalent. Students who viewed the cost as unjustified frequently cited affordability concerns or felt that the textbook did not offer sufficient benefits relative to its price. From this analysis, we identified **five major themes**. Among student responses that expressed **negative sentiment** - indicating that the cost was not justified - we observed the following themes: 1) *Advocates for Free Resources* - emphasis on affordability and a preference for freely accessible alternatives; 2) *Dissatisfied* - perceived lack of added value compared to free resources or identification of specific flaws; 3) *Not Helpful for Learning* - reported misalignment with learning needs or limited educational benefit. Among students who expressed **positive sentiment** - indicating that the cost was justified - we observed two additional themes: 1) *Satisfied* - found the textbook fairly priced and effective. 2) *Adequate* - acknowledged limitations but generally found the resource helpful and worth the cost.

To contextualize these findings, we conducted a parallel analysis of the free textbook question (Q15) using the same coding procedure. Responses were mostly positive, with students highlighting accessibility, clarity, and overall usefulness (Figure 7b). From this analysis we have identified **six major themes**. Themes under **negative sentiment** - responses that reflected dissatisfaction or criticism about the resource - include the following: 1) *Dissatisfied* - General dissatisfaction with quality or usefulness; 2) *Inconveniences* - Cited issues such as interface usability or incomplete content; 3) *Not helpful for learning* - criticized depth, clarity, or organization. Themes under **positive sentiment** - responses that emphasized satisfaction with and appreciation for the resource - included: 1) *Satisfied* - found the resource sufficient for course needs with no major issues; 2) *Helpful for Learning* - highlighted engaging content and alignment with course material; 3) *Advocating for Free resources* - valued the free and equitable access the textbook provided.



(a) Students' response to *"In your opinion, is the cost of a paid eTextbook justified?"*



(b) Students' response to *"What are your thoughts on the quality of a free eTextbook?"*

Figure 7: RQ2: To what extent does the perceived cost-effectiveness of a required paid and free eTextbook influence students' satisfaction with the textbook?

5 Discussion

5.1 Quality of Free & Paid eTextbooks

The results of our analysis suggest that students perceive free and paid textbooks to be of comparable quality. As shown in Figure 3, both textbooks received similar distributions of ratings, with the majority of students rating both of them as 'Above Average' or 'Excellent'. A Mann-Whitney U test confirmed that there was no

statistically significant difference between the quality ratings, indicating that students evaluate the two textbooks similarly in terms of the quality of these resources.

To better isolate students' perceptions of quality, we asked which textbook they would prefer if cost was not a factor. Here, 'quality' refers broadly to the content, usability, and overall educational value of the book - essentially, how good the textbook is on its own merits. *With price explicitly removed from the equation, more students favored the free textbook (56.6%) over the paid one (43.4%), as shown in Figure 4.* While this difference was not statistically significant, it is notable that the free eTextbook was slightly more preferred even when students evaluated the materials solely based on quality. Figure 5 illustrates why students favored one eTextbook over the other. The primary reason for preferring the paid eTextbook was its 'Visuals', supporting studies that highlight the benefits of programming visualizations for learning [6]. For both the paid and free eTextbooks, 'Exercises' ranked second, emphasizing their value in helping students engage as programmers.

These findings suggest that students view the two textbooks used in this study as providing similar educational value. Given this perceived equivalence, one might consider the free textbook a more practical alternative, especially when cost is an important factor to consider. While our study is limited to only two textbooks, the results highlight that a no-cost option was rated similarly to a paid one in terms of quality. This may have implications for course material selection, particularly in contexts where reducing financial burden is a priority and where free resources of high quality that meet students' expectations for educational value are accessible.

5.2 Cost-Effectiveness of Free & Paid eTextbooks

In the previous section, we found that when cost was not considered, students evaluated the two textbooks as being of roughly similar quality. However, the results discussed in this section suggest that perceptions shifted once cost became an explicit factor. As shown in Figure 6, a majority of students indicated that the cost of the paid textbook was not justified. Thematic analysis (Figure 7a) revealed common reasons, including affordability concerns and a perceived mismatch between the textbook's price and the benefits it offered. In contrast, the free textbook received predominantly positive feedback, with many students emphasizing its accessibility and adequacy for learning (Figure 7b).

These findings indicate that cost is not merely an external constraint. It plays a meaningful role in how students assess the overall value of a learning resource. This can be understood through the lens of Rate of Gain from Information Foraging Theory, which models the cost-effectiveness of an information source as the ratio of the value it provides to the cost required to access or use it. Applied to our results, this helps explain why students, when perceiving the educational value of both textbooks to be similar, tend to favor the free option: its value-to-cost ratio is higher, making it the more efficient choice.

Expectancy-Value Theory provides a framework to further understand what constitutes "value". According to this theory, students' perceptions of a resource's value are shaped by dimensions such as intrinsic value (interest or enjoyment), utility value (usefulness for achieving goals), and attainment value (personal importance or alignment with one's identity). Many students viewed the free textbook as sufficient for their learning needs, useful within the course context, and more accessible - factors that together contributed to a strong overall perception of value. Taken together, these theories offer insight into why the free textbook was perceived more favorably when cost was explicitly considered.

Taken together, these results highlight the importance of considering both quality and accessibility in textbook selection. Although our findings are limited to a specific context, they underscore how students' evaluations of course materials are shaped by a combination of content effectiveness and cost-related factors, particularly in settings where financial constraints are a concern.

6 Limitations

This study has the following limitations. We evaluated only one paid and one free eTextbook, which constrains the generalizability of our results. Additionally, the comparison spans two different courses. Although these courses share similar structures and are taken consecutively by the same students, contextual differences may still influence perceptions. Thus, our results should be viewed as an initial point of discussion rather than a definitive comparison. While we asked students to assume cost was not a factor when indicating their preference, it is possible that cost and quality were not fully separable in their reasoning. Finally, we did not collect data on how extensively students engaged with each textbook. Without distinguishing between students who read thoroughly and those who only completed required exercises, interpretations of perceived quality must be made cautiously.

7 Conclusion

Our study's central finding is that cost is not merely an external constraint but a factor that fundamentally shapes how students evaluate educational resources. We compared student perceptions of a free and a paid interactive textbook in undergraduate computing and found them to be viewed as largely equivalent in pedagogical quality. When cost was removed from consideration, both received similarly high ratings, and no significant preference was found.

However, when cost was made explicit, evaluations diverged. Most students argued the paid textbook's cost was unjustified, citing affordability and a perceived mismatch between price and benefit. Conversely, the free textbook was praised both for its accessibility and its sufficiency as a learning tool. This aligns with Expectancy-Value Theory: students perceived the free resource as not only useful and accessible but, critically, as fully adequate for achieving their academic goals, thereby maximizing its perceived value.

While our analysis is limited to two specific textbooks, the implications are broad. As institutions seek to reduce financial barriers, our findings suggest that Open Educational Resources (OER) can serve as cost-effective, high-quality alternatives without a perceived compromise in learning. These insights should encourage educators, especially in fields like computer science where high material costs can exclude students, to highly consider OER adoption to promote a more equitable and accessible learning environment.

Acknowledgments

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