Beyond the Bind and Between the Lines: Focus Group Insights Into an Interactive-Online Textbook

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***Abstract*—This research-based full paper describes a qualitative study to gain further insight into how and why an interactive online textbook developed for a Statics and Mechanics of Materials I course affects students' perceived learning. Data gathered to date has indicated positive effects on students, but detailed explanations of what aspects of the textbook are causing these effects have remained vague, unclear, or non-existent. This research serves to better understand the different aspects of learning underpinning the textbook and how, in detail, they contribute to student performance. It further expands and validates the list of best practices for interactive textbooks.**

Colleges and universities continually work to improve their curriculum, teaching efficacy, and student outcomes. Didactic lecturing has been the cornerstone of most institutions' pedagogy; however, it has changed with advancements in educational theory. Flipped classrooms have become increasingly common in academia, as well as courses utilizing project-based learning. Research has shown that when implemented correctly, these methods improve student retention and confidence and, as a result, increase program completion rates. In addition to lecture style, several different learning modes may be used across a school's curriculum. Narrowing the scope to individual courses reveals an often understudied aspect of the classroom—the textbook.

Previous qualitative studies on the interactive, online textbook showed that students felt their required reading material positively impacted their learning of class material, with themes such as "Beneficial" and "Helpful" applicable to numerous open-ended responses coded by the research team. This study, then, is a direct result of these findings, intending to achieve a deeper understanding of the nuances of these general themes. Three focus groups consisting of different genders and majors (n = 4, 7 and 7), were formed and given an identical set of questions concerning the interactive-online textbook. Two interviewers were present in each group to moderate the discussion. The focus group conversations were recorded using the university-approved recording platform, Panopto, and transcribed using NVivo, with a researcher making corrections if needed and confirming the accuracy of each transcript.

The transcripts were then coded according to Creswell, and specific themes emerged. The most commonly discussed topic was the benefits of the embedded questions within the textbook. Students noted that the questions allowed for immediate feedback, validating their understanding of the content before moving on to new material. For example, if they answered a question incorrectly, the problem would provide a hint to help guide them to the correct answer. In addition, the students enjoyed the low-stakes learning environment of the text as the questions were scored on participation and not correctness. Another finding was that students found the organization of the textbook to be helpful. The text was built using Cognitive Load Theory and followed a Concept-Example-Question format. Students appreciated how this layout separated the material into smaller, easier-to-understand sections. These findings are invaluable to the development and implementation of interactive and engaging online textbooks.

***Index Terms*—Interactive-online Textbook, Digital Textbook, e-book, Active Learning, Student Engagement**

I. Introduction

In collegiate education, adopting a multifaceted instructional approach—both inside and outside the classroom—is essential for fostering student comprehension and proficiency. Various documented in-class activities, such as in-person and computer-based think-pair-share exercises [1, 2], and polling [3] have been proven to enhance student engagement and learning. Additionally, there exist complementary out-of-class activities and techniques, like flipped course formats in both synchronous [4]–[6] and asynchronous instruction [7], as well as the utilization of Makerspaces [8, 9], which serve to reinforce core concepts and practical skills. Another trend has been the use of digital textbooks (referred to as e-books), which can either be static (e.g., simply a PDF) or interactive (e.g., have interactive mechanisms such as animations, questions with feedback, and hyperlinks to external, online resources).

There are many benefits of transitioning textbooks to digital formats: publishing costs can be cut [10, 11]; environmental impacts can be minimized; and portability can be improved [12]. While most conventional textbooks have been converted to basic digital formats like PDFs, with limited features such as hyperlinking, others have evolved into web-based platforms, gradually incorporating advancements like animations and embedded questions to enhance interactivity and engagement [13]. Regarding reducing costs, over the past five decades, studies on textbook prices have revealed alarming trends. Textbook prices have soared by 1,000% since the late 1970s to the mid-2010s, with increases outpacing inflation rates significantly [14]. For instance, between January 2006 and July 2016 alone, textbook prices surged by 88% [15]. Recent data indicates a continued upward trajectory, with textbook prices rising by 36% from July 2011 to July 2021 [16].

To contextualize these increases, current collegiate textbook prices range from $68 to $182, amounting to an annual expenditure of approximately $1,200 to $1,300 for students, comprising 26% of the total tuition cost at a public four-year university [14, 17, 18]. Prices of the PDF versions of print textbooks have also been increasing, which is counterintuitive. High prices often deter students from purchasing required textbooks, with surveys indicating that significant proportions of students opt not to buy them due to cost concerns [14].

This lack of textbook usage is evident across various disciplines. Studies examining undergraduate students' textbook utilization habits reveal concerning patterns. In a 2008 study involving finance students, approximately 20% of the respondents said they did not read their textbooks, while around 40% said they spent less than an hour per week with their assigned texts [19]. Similar findings were noted among psychology students in another study [20]. Insights from the 2017-2018 National Survey of Student Engagement (NSSE) illuminate this issue quite clearly; 74% of first-year and 75% of senior students seldom consult their texts when readings are assigned, with only a quarter consistently completing the readings before class [21]. Cost emerged as a significant deterrent from students purchasing a textbook, leading many students to seek cheaper alternatives when required to buy textbooks for courses. Furthermore, another study highlighted students' motivations and challenges regarding textbooks, indicating that the primary driver for purchasing textbooks is often course requirement or homework dependency rather than perceived effectiveness as a learning tool [22].

Cost is a significant motivating factor in whether or not students buy a textbook, whether print or digital, but simply having a textbook does not mean the student is using the textbook. With a digital textbook, there are opportunities to increase usage and engagement with this educational resource since students currently do not think it is an effective learning tool. Research suggests that merely transitioning to digital formats does not inherently enhance student engagement with their textbook. While digital textbooks offer affordability and convenience, students frequently express dissatisfaction due to technical issues, lack of interactive features, and readability concerns; however, surveys indicate students' openness to new textbook formats and delivery methods. Improving student engagement includes restructuring textbooks to incorporate interactive components [6]. For example, a survey of chemical and biological engineering students revealed a preference for electronic textbooks with interactive features, suggesting a willingness to embrace innovative learning tools [23]. Studies on incorporating interactive textbooks have shown positive student responses to features such as interactive problems, animations, and simulations, with students reporting increased motivation and efficiency in learning [24]–[26].

An ancillary benefit of adopting interactive e-books is increased student performance. Many studies have been conducted to see whether a digital textbook offers advantages over a traditional print textbook. Much research examining the impact of interactive learning tools on student performance demonstrates promising outcomes. Studies assessing web-based interactive courses and textbooks have shown significant improvements in student performance, particularly among those who engage more extensively with interactive exercises [27]–[30]. Additionally, experiments reducing text length in educational materials demonstrated improved student assessment scores, suggesting that concise, focused content can enhance learning outcomes [31]. O'Bannon et al. investigated student achievement using an interactive digital textbook instead of traditional lectures in a technology-oriented course. Their study revealed that students using the digital textbook performed better in post-test assessments when compared to those taught using traditional lectures. The students reported favorable perceptions of the text's clarity, assignment assistance, learning motivation, and overall course interest. Despite these benefits, challenges related to technology accessibility were noted [24].

Similarly, Liberatore studied the impact of interactive textbook use on student performance and outcomes in an introductory chemical engineering course. The study, motivated by the finding that a large majority of students do not fully engage with assigned texts, evaluated the use of an interactive digital textbook, a ZyBook, compared to a traditional book. The study found a significant correlation between reading completion and student grades, with higher-performing students demonstrating greater reading engagement. Student feedback highlighted the interactive textbook's interactivity, conciseness, and clarity, ultimately indicating a high level of usefulness in the course [25]. Additionally, research by French et al. indicates that textbook requirements and grading policies significantly influence students' engagement with course materials. Despite these findings, the correlation between reported textbook usage and overall course grades remains inconclusive [32]. Lim et al. studied the effects of traditional (or static) e-books and interactive e-books on undergraduate students' achievement in an introductory statistics course. They found students who used interactive e-books scored higher on assessments than those who used static e-books and recommended that e-books have some level of engagement and interaction [33]. Lee et al. found that with increased usage of e-books, students' demonstrated increased academic interest and performance. They also found that low-performing students benefit the most from using e-books [34]. Contrasting these findings, Spencer et al. reviewed and analyzed 33 articles written about e-books and found that many showed promising features (students enjoyed them, low cost, etc.) and that there were some links between interactive e-books and increased engagement and performance. They did note the relation between textbook format (e.g., static and interactive e-books) is muddled [35]. This idea is furthered by Pabst et al., who compared the formal assessment scores of students who used a traditional Statics and Mechanics of Materials book to those who used an interactive online textbook. They found no statistically significant difference in assessment scores between the two cohorts but did find the students who used the e-book had a positive learning experience and felt more engaged; the

students using the print book had a more neutral or negative learning experience [36].

Digital textbooks are not a "silver bullet" though, and they have to be not only carefully constructed to foster engagement and interactivity but have to be implemented effectively within a curriculum. Tlili et al. reviewed 123 empirical studies on e-books used internationally. They found one of the most significant hurdles to the effective implementation of e-books was the lack of training students and instructors had with this new teaching medium and how the e-books are incorporated with other teaching methods to create a better learning environment for the students. Still, they did note the reduced financial burdens of e-books on students is a positive [11]. Roberts et al. focused on the educator's usage of e-book features, as opposed to the typical studies that focused on student usage and student learning via e-books. They found instructors do not use many of the features that e-books may offer and need specific professional development oriented toward using these newer teaching materials, which is reflected by the sentiments of Tlili et al. [11]. They found no difference in student learning when using a traditional paper or e-book, and also found that students need to be educated on the features of e-books to maximize their experiences with them [37]; these findings align with those of Pabst et al. [36]. A review of the literature published on various digital textbooks shows mixed results about their impact on student performance but generally positive student perceptions about their effectiveness. More research must be conducted to understand students' perceptions of these texts and how to increase their impact.

The textbook in this study is authored by research team members and used in an introductory Statics and Mechanics of Materials course at a large university. The text is titled "Statics and Mechanics of Materials: An Example-based approach" [38]. The book makes use of several strategies to engage with students. The textbook has questions embedded in the assigned readings that students must answer before proceeding to the next section, allowing them to check their understanding of the material as they progress through the text. These questions provide immediate feedback on whether they answered the problem correctly. When incorrect, the students receive a premade hint based on the most common error to help them solve the problem. The problem provides the correct answer and explains the solution method upon completion. This type of problem extends to the homework and review problems and the worksheets done during part of each lecture. Two other unique features of this text are that a student co-authored it and that it followed Cognitive Load Theory [39]. Details on the book's development can be found in literature [40].

Research into the effects of e-books is ongoing. The research team initially used only open-ended survey questions to collect information on student perceptions about the textbook and its perceived effects on them [30, 36, 40]. This data, however, eventually became insufficient to draw any further conclusions or future work. Student responses to survey questions became stagnant, coalescing around certain words or phrases that were vague, such as "interactive" or "helpful." While these are promising on the surface, more detailed information concerning the textbook, and to a lesser extent, the course structure and how the text fits into it, needs to be collected and analyzed to understand further precisely what aspects of the book students found "interactive" or "helpful," and how the text could continue to be improved and enhance student outcomes. To this end, the research team conducted focus group interviews to ascertain in-depth answers to student's perceptions of the developed e-book.

II. Methodology

A qualitative study was performed using focus groups to gain insight into students' perceptions of the textbook. Each focus group used two interviewers and was composed of students currently enrolled in the introductory Statics and Mechanics of Materials course. Students in each group were selected based on availability or preferably selected randomly when possible. The three groups covered students from different engineering majors, years of study, and gender, having n = 4, 5, and 7, respectively.

The groups were all asked the same questions. They were also given the question set for reference during the interviews, with the interview style being semi-structured, allowing the students some freedom in discussing the questions and other topics that may have arisen during the conversation. The students were guided back on track only if necessary. The questions are shown below:

Q1 a) Did you like having to use the Top Hat textbook? b) What mode of learning, or combination of modes, did you like most? c) Are there any other features that you would like to see in the book?

Q2 a) What do you think the most negative aspect of the textbook is? b) What changes would you recommend for the book?

Q3 a) What do you think about the workload of this instruction method/course, in comparison to other courses? b) What are your typical habits in other classes when using your textbook? c) Did using this textbook instill any beneficial habits with the way you study/prepare for classes?

Each session lasted 40-54 minutes, with one hour being the maximum allotted. The audio data was collected using a microphone connected to a recording device. No visual data was collected for the study. The data was kept on the university's approved storage system.

The focus group data was then transcribed using NVivo and then verified by a research team member. Unfortunately, the second focus group data could not be used; this cohort could not focus on the questions and repeatedly discussed off-topic subjects.

Responses were analyzed according to Creswell et al. [41]. The transcripts were first read through to obtain an understanding of the conversations. They were then read through again,

and codes were assigned to different parts of the transcripts. Themes (and their definitions) were created per the various codes noted in the interviews. The two analysts then met and discussed their themes until a final list of categories was agreed upon. The transcripts were then coded independently and the results were compared, employing an independent arbitrator to assist in resolving disagreements between analysts if they occurred. The final results were then obtained and examined for trends and instances of each theme, presented in the Results and Discussion section.

III. Results & Discussion

Despite reading through the transcript of each focus group, it was unclear what themes would emerge during the qualitative analysis. It became clear that the two focus groups had some overlapping themes, some of which were unique to each group and some of which were diametrically opposing. Perhaps unsurprisingly, no single list of themes could be used to code the conversations of both groups. It was also not possible, or at least not advisable, to have one list of themes for all questions asked in each interview. After coding was completed, two other findings were revealed that were essential to understanding the data. The first was that parts Q1a) should be merged into Q1b) of Q1 for the analysis as they were intricately linked. If students liked using the textbook, they would immediately describe why. The second finding was that students would rapidly move between the interview questions (Q1 and Q2, in particular) during conversation and, in addition, discuss topics more indirectly related to the exact question set than directly related. Per their responses, it made sense to organize positive comments about the textbook, course, etc., into Q1 and negative comments into Q2. Q3 was not affected by this, as students were straightforward when answering these questions.

The coding schemes developed for each question for the first focus group are shown in Tab. I. The number of codes assigned for each theme per question and the percentage of the total number of assigned codes for each theme per the entire question set (e.g., the percentage of codes for Structure−Negative for all codes assigned in both parts of Q1 for the first focus group is shown as well). For Q1b), "What mode of learning, or combination of modes, did you like most?," the most commonly coded theme was Lecture Videos−Positive, being assigned ten times, representing 13% of all codes assigned in the transcript, and 34% of codes applied in the question. Students in the first focus group found the lecture videos to be an excellent resource for learning course content and were preferred over reading the textbook. One student noted:

> *I didn't really like using the online textbook... especially in Top Hat you can't really zoom in or out of reading it. You can open it in a reading view, but it still shows the same number of lines per page. And I'd love to see the entire page all at once, especially when looking at example problems. You have to keep scrolling to see the entire solution, rather than being able to see it all at once. So then having to scroll back and forth between like solving the question and then comparing it to how the example did it is kind of annoying so I don't really like that and I like the video notes a lot better than the textbook because I feel like it got to the point more so.*

The next most common theme was Organization−Positive (4), representing 14% of codes found in Q1b). Students noted that how the textbook is laid out in Top Hat was beneficial, especially since the textbook, homework, and quizzes were all in the same central location. A student noted:

> *...relative to a normal textbook... I thought it was probably more helpful. And even in like a more basic sense, I kind of like that everything was in one place for the course rather than other courses I've taken where they use multiple platforms for like the homework or the quizzes or even for the reading if they have a separate textbook. So I thought that made it... a lot more intuitive to just go to the same website for everything.*

They also enjoyed how Top Hat and the embedded questions break the book into smaller, easier-to-understand sections. An interesting theme revealed in the interview was Participation (2). It was already known that several students appreciated having the embedded questions in the text be mandatory to move to the next section, but their feelings on how these questions were scored were not. While representing only 7% of codes, it was intriguing that having them evaluated only on participation reduced stress and made some students more likely to try the problems. A student in this focus group noted:

> *Yeah, I liked using the Top Hat textbook. I thought the interactive side was a lot better compared to other virtual text books and... I like the immediate feedback and I like how most of the problems show steps too. [I]n other textbooks, you just flip to the back and it has answers where it's just the number and it's usually only like the odd numbers of all the questions. And I think having problems that were forced to do forces me to actually learn it and know how to do it and go to office hours if I need help. Whereas [with] other textbooks where it's like not assigned I usually won't do it, or won't set the time aside to do it.*

The coding schemes developed for each question for the second focus group are shown in Tab. II. The number of codes assigned for each theme per question and the percentage of the total number of assigned codes for each theme per the entire question set (e.g., the percentage of codes for Structure−Negative for all codes assigned in both parts of Q1) for the second focus group is shown as well. Concerning the second focus group, the most commonly coded themes were Writing (8) and In-class (8), each representing 24% of codes applied in the transcript. In stark contrast to the first focus group, these students did not find the lecture videos useful and

TABLE I
CODING SCHEMES AND ANALYSIS OF THE FIRST FOCUS GROUP

CATEGORICAL DESCRIPTION	CODE	Total Count	% Total Assigned Codes	Q1b)	Q1c)	Q1 Total Count	% Q1 Assigned Codes	Q2a)	Q2b)	Q2 Total Count	% Q2 Assigned Codes	Q3a)	Q3b)	Q3c)	Q3 Total Count	% Q3 Assigned Codes
Organization (Positive)	Speaks to how the book is setup/laid out well and how it benefits students, including homework and quizzes. Functions within the book work well and features are praised.	4	5.3%	4	–	4	13.8%	–	–	–	0.0%	–	–	–	–	0.0%
Organization (Negative)	Speaks to how the book is poorly setup/laid out and how it negatively affects students, including homework and quizzes. Functions within the book may not work well or may be missing entirely.	6	8.0%	–	–	–	0.0%	3	3	6	28.6%	–	–	–	–	0.0%
Structure (Positive)	Speaks to how the course is setup/laid out and how this benefits students. Includes the different modes of learning.	3	4.0%	3	–	3	10.3%	–	–	–	0.0%	–	–	–	–	0.0%
Structure (Negative)	Speaks to how the course is setup/laid out and how negatively affects students. Includes the different modes of learning	5	6.7%	–	–	–	0.0%	3	2	5	23.8%	–	–	–	–	0.0%
Feedback	Found the hints, solutions, and notification of correct/incorrect answers helpful. Liked that they were immediate	3	4.0%	3	–	3	10.3%	–	–	–	0.0%	–	–	–	–	0.0%
Problems	Speaks to how the video and text questions, homework questions, quiz questions, and exam-style questions are beneficial to learning or that students desired more of them.	5	6.7%	3	–	3	10.3%	–	–	–	0.0%	–	2	–	2	8.0%
Mandatory	Students liked being required to do problems before lecture or enjoyed being prepared for lecture because of it.	2	2.7%	2	–	2	6.9%	–	–	–	0.0%	–	–	–	–	0.0%
Lecture Videos (Positive)	Students appreciated the lecture videos, found them beneficial to their learning, or reduced their course workload or time spent on the course	10	13.3%	10	–	10	34.5%	–	–	–	0.0%	–	–	–	–	0.0%
Lecture Videos (Negative)	Students did not like the lecture videos or found aspects of them not helpful. The videos could use improvement	2	2.7%	–	–	–	0.0%	1	1	2	9.5%	–	–	–	–	0.0%
Time Constraints	Felt tasks took longer than necessary, to be a poor use of time, or had a lack of time	3	4.0%	–	–	–	0.0%	3	–	3	14.3%	–	–	–	–	0.0%
In-class (Positive)	Speaks to how worksheets are beneficial to learning. Introduces students to their teammates and encourages team work.	2	2.7%	2	–	2	6.9%	–	–	–	0.0%	–	–	–	–	0.0%
In-class (Negative)	Speaks to how worksheets were not beneficial to learning. Introduces students to their teammates but failed to encourage team work.	2	2.7%	–	–	–	0.0%	2	–	2	9.5%	–	–	–	–	0.0%
Participation	Students felt the participation only aspect of many of the problems reduced their stress, made them more likely to work on problems, or reduced their work load for the course	2	2.7%	2	–	2	6.9%	–	–	–	0.0%	–	–	–	–	0.0%
Reflection	Found the reflection questions to be useless or to need improvement	3	4.0%	–	–	–	0.0%	2	1	3	14.3%	–	–	–	–	0.0%
Background	Noted that their college background could save them time and effort in the course	3	4.0%	–	–	–	0.0%	–	–	–	0.0%	3	–	–	3	12.0%
Similar Work	Workload for class comparable to other courses	1	1.3%	–	–	–	0.0%	–	–	–	0.0%	1	–	–	1	4.0%
Less Work	Workload for class was more than other courses	4	5.3%	–	–	–	0.0%	–	–	–	0.0%	4	–	–	4	16.0%
More Work	Workload for class was less than other courses	4	5.3%	–	–	–	0.0%	–	–	–	0.0%	4	–	–	4	16.0%
Limited Use	Students either do not use their textbooks at all or do not use them much besides working practice problems.	8	10.7%	–	–	–	0.0%	–	–	–	0.0%	–	8	–	8	32.0%
No Comparison	Felt textbook did not influence classroom habits or that textbook and class were too different to instill beneficial behaviors in other classes	3	4.0%	–	–	–	0.0%	–	–	–	0.0%	–	–	3	3	12.0%

instead preferred reading the textbook to learn course material. A student from this focus group commented:

> *I personally like don't watch the videos, I just do the reading and then I do the video questions.*

The students also felt the in-class worksheets were beneficial to learning. These worksheets reinforced key course concepts, and because these were done as a group, the students noted that it prepared them for when they would need to work as a team on the class project.

For Q1c), "Are there any other features that you would like to see in the book?" minimal themes were identified. None were obtained from the first focus group, and only two themes (with one code assigned for each) were recorded from the second focus group. The two themes discovered, however, were interesting enough to warrant their own categories. One student noted that having simulations (theme: Simulation) in the text could help to visualize how stresses manifest within a structure and how strain results in deformation. Another student wanted a method to flag any possible errors in the book relating to the written sections or the assigned problems (theme: Alert). Upon further questioning, the student said that while rare, there were a couple of cases where a problem answer was incorrect, leading them to believe their answer was incorrect when it was not, hindering their understanding of the material.

The coding scheme and associated assigned number of codes and percent breakdown for the first focus group for Q2a), "What do you think the most negative aspect of the textbook is?" is again shown in Tab. I. A couple of themes were particularly interesting, with their details not being seen before. Organization−Negative (3) and Structure−Negative (3) each represented 21% of coded responses. Students noted that a major source of irritation when using the textbook is that the lecture naming system provides only a number and does not describe its contents. Students also felt that the in-class aspect of the lectures could be improved. Each lecture has an in-class example in addition to the in-class worksheet. They felt that the examples would often go on too long, leaving little time to complete the worksheet, essentially making it homework. The group generally felt that the time spent in the lecture could be used more effectively but were torn on how best to use it.

The coding scheme and associated assigned number of codes and percent breakdown for the second focus group regarding Q2a) is again shown in Tab. II. The two most common themes were Organization−Negative (7) and Lecture Videos (8), representing 47% and 41% of assigned codes, respectively. Similar to the first group, the students strongly disliked the lecture naming system. They also disliked not having answers for the quizzes in the class as they wanted them for studying. For Lecture Videos, unlike the first focus group, this collection of students did not like the videos. They found them overly concise and lacking in sufficient detail, preferring to use the textbook to understand course content.

Unlike Q1a) and Q1b), which were easily merged, Q2a) and Q2b) were different enough to be coded separately, although some themes overlapped as the two questions are somewhat similar. The coding scheme and associated assigned number of codes and percent breakdown for the first focus group for Q2b) is, once more, shown in Tab. I. For Q2b), "What changes would you recommend for the book?," the most common theme is Organization−Negative (3), representing 43% of assigned codes. Students again hammered the issue with the lecture names, but this time, they offered solutions on how to fix the problem if they could not be renamed. The second most common theme was Structure−Negative (2), representing 29% of coded parts of the interview. One way the textbook could be improved, according to one student, is that the lecture videos should be incorporated directly into the text or that at least the links for each video should be provided, thus further centralizing course materials around the online textbook. This is possible given Top Hat's platform, however, the researchers and instructors would lose valuable data in terms of student's viewership of the lecture videos.

The coding scheme and associated assigned number of codes and percent breakdown for the second focus group regarding Q2b) is, once more, shown in Tab. II. Concerning Q2b), the group placed a greater emphasis on the problems within the text. The themes Problems (6) and Problem Types (6) were the most prevalent ones found by a significant margin, with each representing 38% of assigned codes. The students recommended that the authors add significantly more problems to the text; the 316 embedded questions, 76 example problems, 175 lecture video questions, and 167 in-class worksheet questions were not enough to satisfy their desire for content. These numbers do not reflect their homework and quiz question counts.

They wanted to see more of all types but in particular those similar to the type that are on the exams. This was an interesting finding as most of the book problems are more difficult than the exam questions, especially as the exam questions are multiple-choice Fundamentals of Engineering Exam problems and the textbook is not. These sentiments possibly refer to the fact that students want more practice problems to enhance their pattern recognition skills instead of having a fundamental understanding of the course material [42]. In regards to problems, specifically scaffolded problems, a student noted:

> *Problems... I feel it's the difficulty of the questions... some questions are way easier than you think they are. And it's literally one line of work. But the practice that we're doing is multiple lines... maybe some of these practice problems can be like the simpler ones and then work up.*

Another interesting finding is the students' thoughts on the reflection questions, themed as Reflection (3). A set of open-ended questions provided to make students think about their conceptual understanding of the material is found at the end of each chapter in the textbook. In both Q2a) and Q2b), it was noted that these reflection questions were poorly designed, as the participation-only aspect of the textbook questions resulted

TABLE II
CODING SCHEMES AND ANALYSIS OF THE SECOND FOCUS GROUP

CATEGORICAL DESCRIPTION	CODE	Total Count	% Total Assigned Codes	Q1b)	Q1c)	Q1 Total Count	% Q1 Assigned Codes	Q2a)	Q2b)	Q2 Total Count	% Q2 Assigned Codes	Q3a)	Q3b)	Q3c)	Q3 Total Count	% Q3 Assigned Codes
Lecture Videos	Students did not like the lecture videos or found aspects of them not helpful. The videos could use improvement	9	10.2%	–	–	–	0.0%	7	2	9	27.3%	–	–	–	–	0.0%
Writing	Writing is concise, and easy to read and understand	8	9.1%	8	–	8	23.5%	–	–	–	0.0%	–	–	–	–	0.0%
Organization (Positive)	Speaks to how the book is setup/laid out well and how it benefits students, including homework and quizzes. Functions within the book work well and features are praised.	2	2.3%	2	–	2	5.9%	–	–	–	0.0%	–	–	–	–	0.0%
Organization (Negative)	Speaks to how the book is poorly setup/laid out and how it negatively affects students, including homework and quizzes. Functions within the book may not work well or may be missing entirely.	10	11.4%	–	–	–	0.0%	8	2	10	30.3%	–	–	–	–	0.0%
Alert	Desire a way to alert the authors of possible math, spelling, or grammar errors in the text	1	1.1%	–	1	1	2.9%	–	–	–	0.0%	–	–	–	–	0.0%
Mandatory	Students liked being required to do problems before lecture or enjoyed being prepared for lecture because of it.	2	2.3%	2	–	2	5.9%	–	–	–	0.0%	–	–	–	–	0.0%
In-class	Speaks to how worksheets are beneficial to learning. Introduces students to their teammates and encourages team work.	8	9.1%	8	–	8	23.5%	–	–	–	0.0%	–	–	–	–	0.0%
Feedback	Found the hints, solutions, and notification of correct/incorrect answers helpful. Liked that they were immediate	4	4.6%	4	–	4	11.8%	–	–	–	0.0%	–	–	–	–	0.0%
Structure (Positive)	Speaks to how the course is setup/laid out and how this benefits students. Includes the different modes of learning.	2	2.3%	2	–	2	5.9%	–	–	–	0.0%	–	–	–	–	0.0%
Structure (Negative)	Speaks to how the course is setup/laid out and how negatively affects students. Includes the different modes of learning	1	1.1%	–	–	–	0.0%	1	–	1	3.0%	–	–	–	–	0.0%
Simulation	Adding simulations to the text would benefit students	1	1.1%	–	1	1	2.9%	–	–	–	0.0%	–	–	–	–	0.0%
Problems	Speaks to how the video and text questions, homework questions, quiz questions, and exam-style questions are beneficial to learning or that students desired more of them.	9	10.2%	1	–	1	2.9%	1	6	7	21.2%	–	–	1	1	4.8%
Problem Types	Want more problems as well as the types of problems including difficulty and answer type, e.g., multiple choice.	6	6.8%	–	–	–	0.0%	–	6	6	18.2%	–	–	–	–	0.0%
Study Guide	Study guide for exam is useful. Names lectures with their associated topics	5	5.7	5	–	5	14.7%	–	–	–	0.0%	–	–	–	–	0.0%
Similar Workload	Workload for class comparable to other courses	4	4.6%	–	–	–	0.0%	–	–	–	0.0%	4	–	–	4	19.1%
Due Date	Day and time of assignments being due in is poorly selected. Homework not always posted on time.	4	4.6%	–	–	–	0.0%	–	–	–	0.0%	4	–	–	4	19.1%
Limited Use	Students either do not use their textbooks at all or do not use them much besides working practice problems.	7	8.0%	–	–	–	0.0%	–	–	–	0.0%	–	7	–	7	33.3%
Prep	Having material available before lecture aids in learning. Students speak positively of the teaching pedagogy.	5	5.7%	–	–	–	0.0%	–	–	–	0.0%	–	–	5	5	23.8%

in students entering anything for an answer to receive credit. One student recommended changing these questions so they are at least briefly reviewed before credit is given out.

For Q3a), "What do you think about the workload of this instruction method/course, in comparison to other courses?," looking at the first focus group, the two most common themes were More Work (4) and Less Work (4), each representing 33% of codes assigned to this question. Many of these codes were found together within the same sentence. Several students explained that the course was or seemed like more work at the

start, but as the semester went on, it became evident that the workload was no different than any other course. A finding not seen before was the theme Background (3), composing 25% of codes. A few students discussed how some of the Mechanical Engineering courses, especially those that already had a lesson on stress and strain, reduced the difficulty of the class and, thus, their workload compared to their classmates in other engineering majors such as Bioengineering.

For Q3a), looking at the second focus group, the most common themes were Similar Workload (4) and Due Date (4), each representing half of the total number of assigned codes for the question. Both focus groups found the workload similar to other courses they had taken, but the second group complained considerably about the due dates for the homework, quizzes, etc. Students had one week to complete their homework (e.g., assigned Friday and due the following Friday), and respondents were adamant that they should have at least one weekend to work on their homework. The researchers were befuddled by their statement. The students were, however, unable to come up with due dates that satisfied everyone present.

The most common theme for Q3b), "What are your typical habits in other classes when using your textbook?" found in the data for the first focus group was Limited Use (8), representing 80% of coded responses. This was expected since, as discussed in the Introduction section of this paper, student usage of textbooks has decreased steadily over time. The second focus group was very similar to the first, with the theme Limited Use (7) having the only assigned codes for the question. One student perfectly communicated this sentiment:

> *Yeah, even for a lot of my classes that don't have videos... like Differential Equations, I'm just taking the Khan Academy course and then doing the homework and the exams and it's going pretty well... I just bought that textbook to do the homework problems because that's what they're in... I haven't flipped through it [at] all.*

Finally, concerning Q3c), "Did using this textbook instill any beneficial habits with the way you study/prepare for classes?," the first focus group felt it did not instill any beneficial habits or that none could be instilled because of how different each course is, a theme referred to as No Comparison (3). The students found the course to be well taught, but applying any study habits they liked to other courses was difficult at best due to its flipped nature. Compared to the first focus group, the second group found that some beneficial habits instilled by the textbook could be applied to other courses, noted by the theme Prep (5), representing all assigned codes for this question. Several of the students recognized the usefulness of pre-lecture work and were attempting to prepare for lectures in other classes by reading through and answering questions in their available course materials.

IV. Conclusion

Three focus groups of students enrolled in an introductory Statics and Mechanics of Materials course were each asked the same questions concerning the course's interactive online textbook, the modes of learning used throughout the course, and their use of textbooks in other courses. The primary purpose of this study was to ascertain a deeper understanding of what aspects of the textbook (and, to a lesser extent, the course as a whole) the students were finding beneficial to their learning and what specific aspects of the text still needed improvement. To this end, two of the three focus group interviews were transcribed, and two research team members performed a qualitative analysis.

Both focus groups found the interactive online textbook to be useful for learning. However, their responses were not identical. The first group found the lecture videos helpful for learning course material and the written portions of the textbook unhelpful. In contrast, the second group found the lecture videos unhelpful and thoroughly reading the textbook helpful for learning course material. This is corroborated by looking at the usage patterns for the lecture videos for students using both a traditional print textbook and the interactive, online Top Hat textbook [43]. Additionally, some students liked the instructor-led examples, while others preferred spending more of the class time on the in-class worksheets. This introduces a new perspective on course design and administration. No singular teaching mode works for all students, and students will pick the mode that best suits their learning style and habits. Thus, a course should not be unimodal in terms of instruction but provide different paths for students to take during their learning journey.

Previous studies had seen the Mandatory theme, but Participation was not. This new finding revealed that how questions are evaluated (i.e., based on correctness versus participation) affected how students approached questions in the text, with students feeling less stress and being more inclined to try these participation-based problems. Several other key takeaways were found in the data. Students in both groups felt the centralization of course materials running through the textbook was helpful to their learning of the course content. This system made the textbook and course in general very intuitive to use and simplified searching for course concepts, homework, and practice problems. The groups also clarified what exactly was meant by "Interactive." Students very often referred to the ability of the questions to provide instant feedback on their responses. This also included the hints that would appear for an incorrect answer and the step-by-step process for solving the problem after the student either answered the question correctly or ran out of attempts.

A final takeaway from these focus group interviews was the importance of organization for the class and, more importantly, the textbook. The groups appreciated how the book was broken into smaller, more understandable sections. This was accomplished by following the Concept-Example-Question format based on Cognitive Load Theory.

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