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INNOVATION VS. TRADITION: MICROBIOLOGY TEXTBOOKS IN THE AGE OF TECHNOLOGY

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Abstract:
In the ever-changing environment of advanced technology use in education, many things are becoming, if not obsolete, then irrelevant. The education market is still teaming with traditional microbiology textbooks from seasoned authors despite the presence of new, interactive, and colorful textbooks that are student-friendly and relevant. Although senior instructors in the field of education continue to assemble collections of textbooks on their office shelves, college students' bags have lightened and now accommodate a laptop rather than weighty textbooks. At Chicago State University (CSU) we surveyed our current student population from years 1 to 4. The 120-students registered in the College of Health Sciences and Pharmacy were enrolled in the study and were asked questions using the Google form survey tool. The questionnaire included questions about all course textbooks including microbiology. The data suggested that less than 1% of the students bought a textbook as mandated in the course syllabi. 5% of the students studied from free Portable Document Format (PDF) versions available through the internet. More than 90% of the students affirmed that they do not find the need or time to read textbooks. They not only found them boring but an absolute waste of their precious time. The students also reiterated that the content of the textbooks was never tested in their exams and assessments. The respondents overwhelmingly declared that the price of textbooks was not the major issue, and their student loans would cover the book allowances. We speculate that with this rising trend of textbook-free course offerings, there will not only be a shortage of useful textbooks in the education market but that young authors in the field of microbiology will become discouraged and disillusioned. It is therefore time to rethink, replan and reverse the fate of students' eternal companion: the textbook.

Keywords: microbiology, traditional textbooks, technology in education, innovative learning methods

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1. Introduction

The role of the textbook in the ever-changing landscape of higher education is continually being discussed and altered. The textbook has frequently served an essential role in the classroom, acting as the primary source for course details as well as inspiring class discussion (Abuloum et al., 2019). It is a reliable companion for both teachers and students, offering an organized framework for learning as well as a common starting point for argumentation (Biermann, 2006).

However, with tremendous developments in technology and a wide range of digital materials now available, the textbook's basic terms are evolving. The textbook is no longer limited to the traditional printed form in today's digital world (Ciampa, 2012). As reported by Simon and Garcia-Belmar (2016), rapid advances in technology have resulted in revolutionary innovations that may drastically change how educational activities happen. These improvements have given students rare access to a large quantity of previously unavailable material. Further, they have impacted how students engage with learning materials. Electronic books, frequently referred to as digital books, have been established as a feasible alternative among these improvements since the end of the 1990s. About every college and university all over the world reported that online learning had replaced traditional classroom instruction because of COVID-19 (Graefen & Fazal, 2023). As substitutes and additions to traditional printed materials, digital textbooks, e-books, online resources, and multimedia tools have been developed (Simon & Garcia-Belmar, 2016).

The textbook continues to be an important part of multiple courses. It serves as the curriculum's cornerstone, giving comprehensive clarifications, theory, and examples that form the course's core. In these circumstances, teachers deliberately pick textbooks that match their teaching goals and rely on them to guide classroom discussions, assignments, and assessments. Students are encouraged to actively participate in the textbook's content by reading, analyzing, and critically assessing it (Rockinson-Szapkiw et al., 2013).

On the other hand, there are courses in which the textbook acts as a supplement. In such circumstances, the textbook provides an overview or guidance, assisting students in navigating the course's multiple topics. To create a full learning experience, teachers can use supplemental materials such as academic publications, research papers, case studies, or multimedia tools. The textbook acts like a resource, offering context and background knowledge while also pushing students to broaden their horizons and do some of their own research (Abuloum et al., 2019).

The boom in technology has resulted in an increase in the number of materials available to educators as well as students. Digital textbooks include interactive components, multimedia components, and search capabilities that improve the learning experience. Open Educational Resources (OER), lecture notes, practice tests, and additional materials are available via online platforms (Rockinson-Szapkiw et al., 2013). These digital tools target a variety of instructional techniques and student preferences by offering flexibility, convenience, and up-to-date information. However, it is essential to be aware that, while technological devices provide multiple advantages, they might

additionally present difficulties. Digital material availability and prices can differ and not all students may have equal access to the necessary resources. Moreover, the large number of online resources could make it challenging for teachers to decide on and evaluate the quality and significance of the content that they offer to their students.

In this ever-changing setting, teachers must carefully evaluate the textbook's effectiveness in their courses. They need to assess the textbook's particular goals for learning, methods of instruction, and student needs to identify how the textbook may best assist their teaching and improve student learning results. They can opt to use a mix of traditional and digital resources (Borcoman, 2019).

While textbooks continue to be an important learning tool in higher education, the way they operate is changing in response to the digital world. To increase student engagement and develop deeper knowledge, teachers are trying out novel ways to use digital resources and change their teaching methodologies. As technology develops, the textbook's functions will be altered providing its continued existence remains a vital and effective tool in the acquisition of knowledge.

2. Literature review

Multiple research projects indicate that a significant number of students prefer printed textbooks to electronic books. Furthermore, studies consistently demonstrate that print textbooks provide a more interesting and comprehensive experience while reading than e-books. The tangibility of printed textbooks contributes to an atmosphere of ease and familiarity for students, which improves numerous aspects of their academic pursuits.

The study conducted by Alfiras and Bojiah (2020) described a survey to assess students' preferences for print and electronic textbooks at Gulf University in the Kingdom of Bahrain. 312 students from various disciplines, including interior design, administrative and financial sciences, human resource management, and communication studies participated in the sample. Although selected at random, the study group had a greater percentage of female students than male students. In accordance with the study's outcomes, a significant majority of the students questioned selected electronic textbooks over traditional paper books.

The research aim of a project by Jhangiani et al. (2018) is to investigate at the views, utilization, and class success of Canadian post-secondary students who were given a commercial or open book in either print or digital formats. The results of the data show that students who use the open textbook in print estimate that its quality is higher than that of an online textbook. In addition, students assigned an open textbook in either format do as well or better than those assigned a commercial textbook. These outcomes support the conclusion that cost reductions to students associated with the utilization of open textbooks do not come at the price of the quality of resources or student performance (Jhangiani et al., 2018).

In the study by Carvalho et al. (2023), students studying in the master’s program "Research in Teaching and Learning of Experimental, Social, and Mathematical Sciences" at the University of Extremadura, Spain were questioned to indicate whether they chose

to learn with printed books or digital books. The research mixes both quantitative and qualitative methods, focusing on content analysis of shares from an online forum with 31 students participating in it. According to the qualitative research carried out with the webQDA software, the majority of university students still prefer to learn from printed books. The students' discussion of this decision highlights the benefit of writing thoughts on something that can be seen, as well as the increased focus and knowledge acquired from reading on paper. The significance of physical involvement and mental benefits associated with the use of printed materials is highlighted in this study, which brings into focus the continual significance of printed books in educational institutions (Carvalho et al., 2023).

A research study including 177 Library and Information Science students enrolled in an Information Science Department took place for the first semester of the 2015 academic year. Three questionnaires were implemented in the study to gather information on personal details, the estimated beneficial effects of various resources, learning strategies, and preferences for reading. The results of this research highlighted students' preference for printed content, demonstrating an increased need for real books. Additionally, the study emphasized the crucial role of two specific traits, specifically relative advantage, and comprehension, in influencing the tendency of students to engage with digital materials for the purposes of reading (Aharony & Bar-Ilan, 2018).

This study by Mizrachi et al. (2018) presents statistical results gathered from a global survey of 10,293 university students which explored their choice of, and habits associated with, academic reading styles. The study aimed to find out if nation-specific features such as educational systems, economic growth, or cultural factors influence students' preferences regarding the media for learning (print or electronic) and participation in routines. The key results show that a nation of origin has little to no impact on reading format preferences among undergraduates, with a significant majority of participants worldwide favoring printed content for educational reading. Moreover, while interacting with print documents, most of the participants indicated increased focus and knowledge preservation, particularly for more extensive materials (Mizrachi et al., 2018).

In opposition to the trend toward for printed textbooks, a growing amount of data indicates that a significant majority of students favor digital textbooks to their printed alternatives. These studies show that aspects like portability, accessibility, and interactive features add to the appeal of digital textbooks. Students appreciate the simplicity of having all their course materials on one device, the ability to easily search for specific information, and the interactive elements that enhance their engagement with their topic. Chavali and Gundala (2022) describe that the rising price of textbooks has a huge impact on higher education students from all over the world. E-textbooks are becoming more common among students, especially those attending university-level courses. There is a significant activity in students' reading behaviors and preferences toward e-textbooks, requiring researchers to investigate students' experiences, attitudes, and views about how they are utilized and their impact on the learning process. This study focuses on undergraduate students at a small midwestern university in the United States. Students

from four different institutions participated in the data collection, with a total of 346 questionnaires collected. According to the statistics, 34.39% of current users in the study showed uncertainty about consuming e-textbooks in the future. Cost-effectiveness, interactive games that improve learning and participation, ease of use, and adaptability are among the primary factors pushing the use of e-textbooks over print textbooks. The paper recommends several strategies that teachers, professionals in technology, developers, and organizations should employ to encourage more students to use digital textbooks, solving the problem of cost (Chavali & Gundala, 2022).

Merkle et al. (2022) explore how students perceive the effectiveness of print textbooks vs e-books, with a special focus on digital books and their impact on student engagement. Results demonstrate that digital books have an extensive range of effects on student participation. While certain kinds of interaction have a beneficial impact, others show a neutral or adverse effect. Furthermore, the success rate of digital publications greatly depends on the course being studied. Further, the study reveals that e-books perform as a regulator in the relationship between textbooks' usefulness and their academic performance contribution. Highly effective online books tend to result in higher levels of academic performance and dedication. (Merkle et al., 2022).

The purpose of this study conducted by Almekhlafi (2022) was to investigate the effect of e-books on educational technology content and to assess student teachers' initial experiences of the effectiveness of digital books for their learning. Using the pretest-posttest method, the study used a quasi-experimental approach with a total of three groups. The first experimental group used a multimedia digital book (iBook), while the second used a non-interactive e-book (iBook PDF). The control group used a printed copy identical in content to the e-book. Preservice student teachers enrolled in a technology course at the United Arab Emirates University made up the participants. In addition, every participant received a post-treatment questionnaire. The data showed no significant differences in course material achievement depending on the type of book studied. Nevertheless, in terms of subject matter learning, initially, teachers were considerably more pleased with the interactive e-book publication. Compared and contrasted with the other variants, they assessed more advantages and fewer drawbacks with the interactive version (Almekhlafi, 2022).

2.1. Current study

The educational marketplace provides an extensive selection of microbiology textbooks that address a broad spectrum of learning methods. For students who prefer a more traditional strategy, regular textbooks consist of rich knowledge and comprehensive clarifications. Options that are online and beneficial to students, on the other hand, involve appealing pictures, interactive tasks, and online resources that improve the learning process and fulfill the evolving needs of modern students.

Our study aims to investigate our students' preferences in both digital and conventional literature. We collected information on their book format preferences and the underlying causes for their preferences through questionnaires.

3. Material and Methods

In this study, a cross-sectional survey design was used. The questionnaire included questions about all course textbooks including microbiology.

3.1. Participants

In the academic year 2022–2023, students at CSU (n = 120) were prompted to respond to an anonymous online questionnaire shared on SurveyMonkey. Among the 120 students who participated, 63 (52.5 %) described themselves as female and 57 (47.5 %) as male. The students were recruited on a voluntary basis. The mean age was 26.43 (SD=3.31), and their ages varied in age from 21 to 37. The study focuses on a broad student population through the course of all four years and provides an in-depth evaluation of their perspectives and experiences. The group included 33 first year (27.5 %), 29 second year (24.2 %), 30 third year (25.0 %), and 28 fourth year students (23.3 %) amongst the total number of participants.

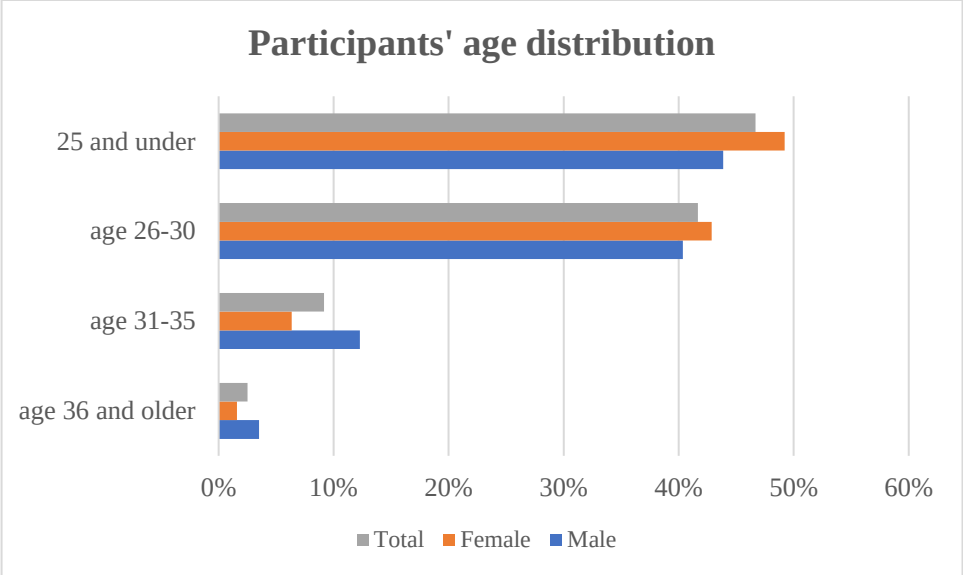

Figure 1: Participants' background information

3.2. Data collection

After two additional emails were sent three weeks apart, an online survey was provided for a total of eight weeks of data collection. The students obtained no financial reward or promotion for participating in the experience. Respondents got information concerning how to complete the survey, and the results remained anonymous. Demographic data that included age, gender, and university grade level was collected.

3.3. Data analysis

Initially, all the variables were examined to find out whether there was any missing data, and it was found that there was none. The statistical analysis was conducted using SPSS software version 20.0 (SPSS Inc., Chicago, IL, USA).

4. Results

According to data collected from a broad group of students, the old paradigm of textbook utilization and usage is going through an important change. Less than 1% of students purchased the needed textbooks, while 5% used free PDF versions available online. More than 90 percent of students stated they weren't interested in or in need of textbooks, and that they experienced time to interact with textbooks (Figure 2).

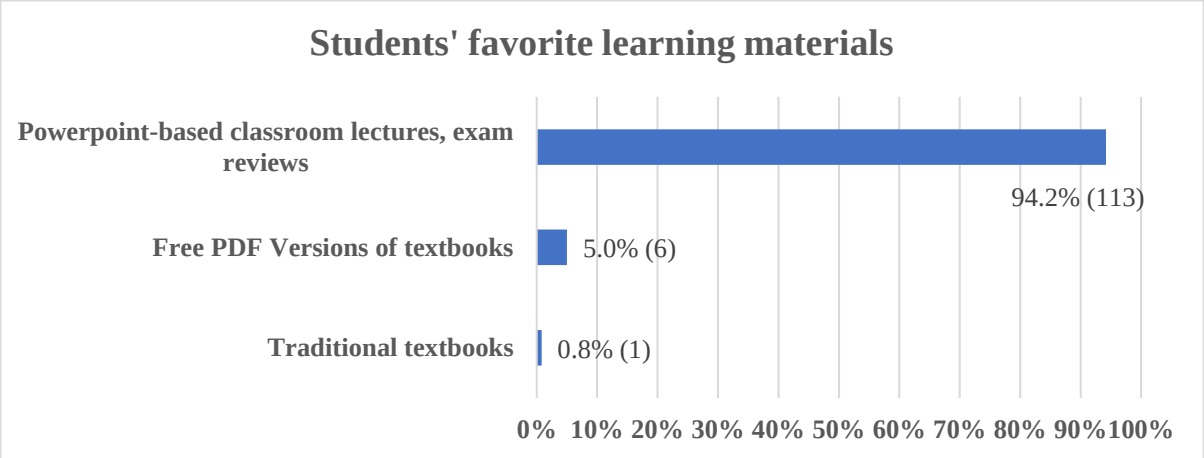

Figure 2: Students' preferred learning materials

According to the study results, a significant proportion of participants (80.8%) prefer to spend their time in front of displays rather than reading books (Figure 3).

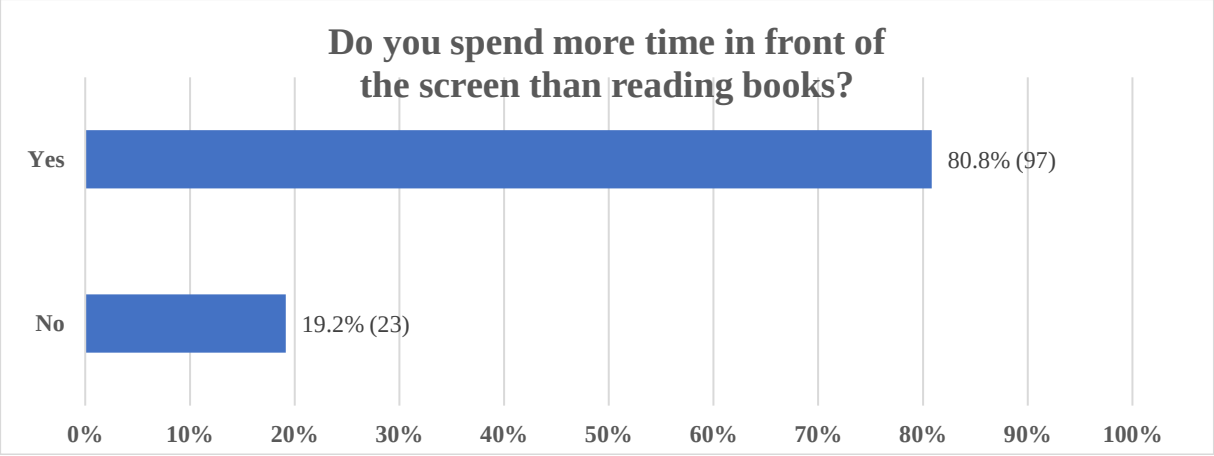

Figure 3: Comparison of screen time vs. book reading time among participants

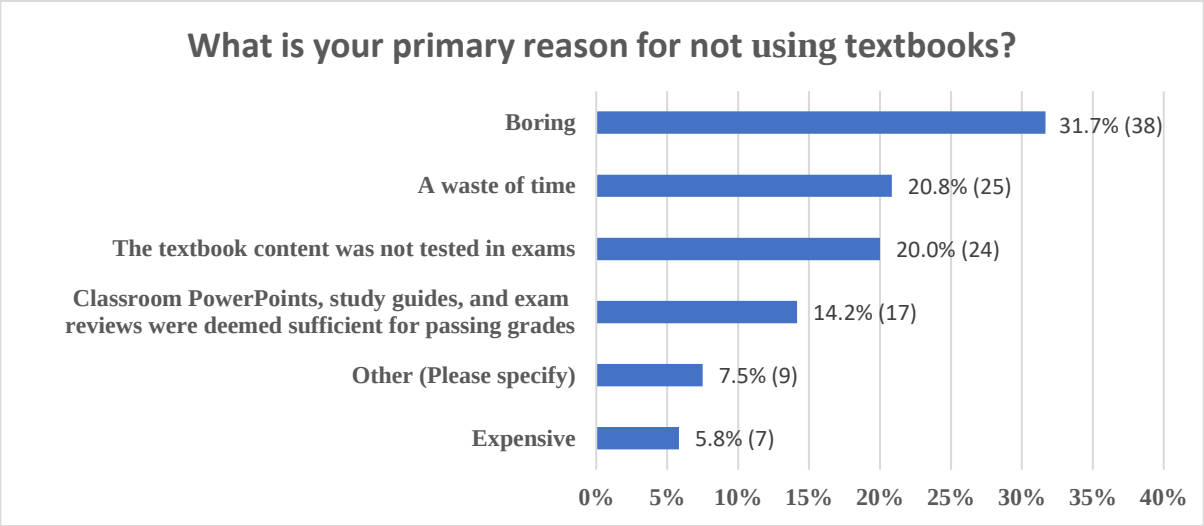

Figure 4: Primary factors influencing non-utilization of textbooks among participants

Approximately 5.8% of respondents said they were frustrated by purchasing textbooks because of their excessive price. The high cost of textbooks limits students' access to education and is an important obstacle to involvement. A significant 20.0% of participants thought that exam questions did not cover textbook material. Students select different study materials that they think are more directly related to test subjects because they believe there is a gap between textbook information and testing methods. About 14.2% of students stated that they were able to complete their classes using only the classroom PowerPoints, study materials, and test reviews. The accessibility of such data reduces the perceived need for textbooks, particularly if alternative materials are sufficiently supportive. The survey revealed that although 31.7% of respondents considered textbooks boring, 20.8% of respondents believed them were a waste of time. These emotions indicate an absence of interest in standard textbook forms, which encourages students to investigate deeper and more engaging educational resources (Figure 4).

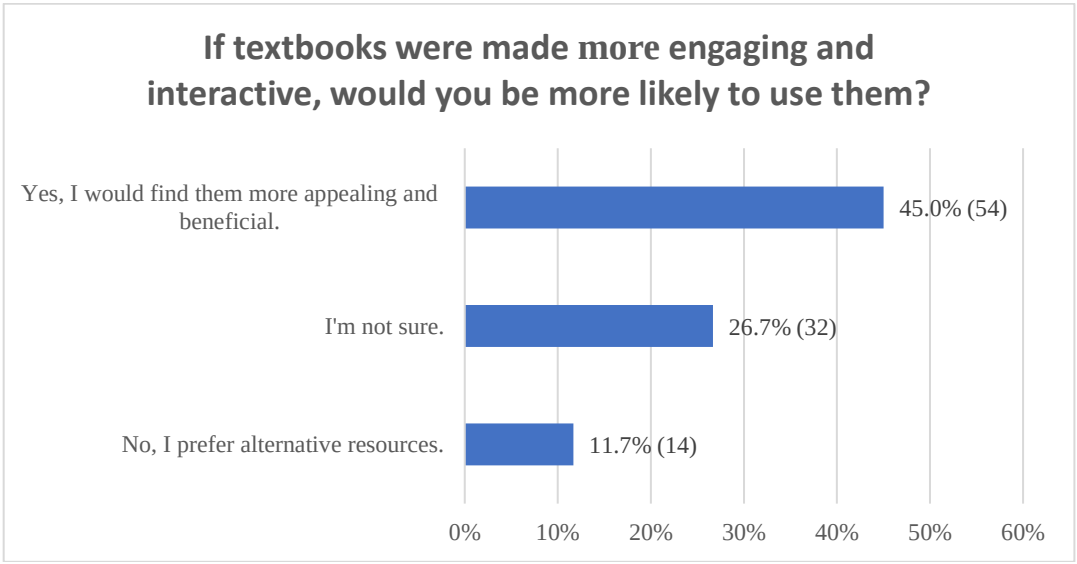

Figure 5: Impact of increased interactivity on students' likelihood of using textbooks

Based on the findings of the survey, nearly half of the respondents, or 45.0%, agreed that they would be more likely to use textbooks if they were made more interesting and interactive. It should be noted that 26.7% of respondents were not clear about their preference; however, this is notable and highlights the need for additional research and evaluation of the potential impacts of interactive textbook designs. Furthermore, 11.7% of participants indicated they favored employing alternative resources, emphasizing how crucial it is to maintain providing a variety of learning materials that meet various learning needs and methods (Figure 5).

5. Discussion

While experienced educators frequently use an assortment of textbooks to improve their teaching, our students showed an obvious preference for digital materials. Students find online resources to be more accessible, enjoyable, and convenient because they can access them from a variety of devices or interact with multimedia data that allows them to understand microbiology theories.

Microbiology textbooks which are interactive and easy to use have multiple benefits. For example, the designs are visually captivating, colorful, and suitable for students' needs, making the educational experience more enjoyable and relevant. Furthermore, multimedia components, interactive exercises, and editable options are provided in these textbooks, allowing students to fully participate and enhance their knowledge of the topic material. As a result, when these interactive textbooks are implemented, much higher student engagement and learning results are often seen.

In the area of education, there has been an obvious trend toward electronic resources in recent years. Our results show that instead of transporting traditional textbooks, numerous students increasingly choose to use laptops and online resources. Moving from printed to digital materials has various advantages, such as mobility and simple access. Students can access their materials at any time and from any place, because of the ease of having all their books in one device. In addition, since immediate alterations could be made in response to novel findings and developments in the field of microbiology, digital resources have the advantage of having up-to-date materials. The use of multimedia tools such as movies, videos, and interactive games enhances the process of learning by making difficult subjects easier for students to comprehend and recall.

A disturbing recent trend in higher education has been the lack of attention to written material in the curriculum. Although many teachers have failed to monitor or enforce their use, the need for these important learning materials has diminished today. Unfortunately, this problem is exacerbated by the fact that academic institutions of higher education do not adequately monitor the introduction of textbooks into courses. University bookstores are struggling to survive because of the decline in their main source of income. To adapt, some stores have given up selling books and started selling college souvenirs instead, which has only exacerbated the problem. This abandonment of textbooks diminishes the value of academic discipline and information development

while making it difficult for students to find complete learning resources. Universities must act quickly to address this issue by encouraging professors to include textbooks in their curricula, helping academic administrations enforce textbook policies, and finding long-term solutions to ensure textbooks are available in university bookstores. Universities can provide their students with a more complete and enjoyable learning experience by recognizing the value of textbooks and by making active efforts.

Textbook-free courses at universities are becoming increasingly popular, raising concerns about a possible reduction in textbook offerings. In response to current educational preferences, this approach may mistakenly discourage young authors from working in certain fields such as microbiology. These emerging authors are less motivated to write new publications and add informative material in their chosen fields because of the reduced demand for textbooks. However, it is imperative to rethink the importance and applicability of textbooks as life companions for students. Textbooks not only provide comprehensive information, but also serve as reliable sources of information for novices and experts alike. In a changing educational environment, it is critical to seek alternatives and instructional materials that meet today's learning preferences while preserving the vast amount of knowledge and benefits that textbooks provide. Striking a balance between innovation and preservation of irreplaceable educational resources is essential to ensuring a well-rounded and complete academic experience.

As we navigate the changing educational landscape, it is critical to look for alternatives and educational materials that fit today's learning preferences while retaining the vast amount of knowledge and benefits that textbooks offer. For students to have a comprehensive and broad academic experience, it is important to strike a balance between innovation and maintaining irreplaceable educational resources.

It is important that teachers, educational organizations, and publishers work together to rethink the role of textbooks in education. Joint efforts can lead to the development of detailed and engaging learning materials that meet contemporary educational preferences. By exploring different design options, such as digital resources or multimedia content, we can adapt to changing contexts while maintaining high standards of learning materials.

Strategies should be developed to ensure a continuous supply of excellent learning resources. These strategies may include using technology to facilitate access to information, planning with printers, or finding open educational resources that are freely available to students. We will survive in the changing educational landscape while maintaining the quality and accessibility of educational materials by supporting new authors, encouraging collaboration, redefining the role of textbooks, and implementing successful solutions. The fascinating and relevant learning experiences that result from this comprehensive strategy will encourage students and motivate the next era of authors and teachers.

5.1 Suggestions

1) Explain to the students the significance and effectiveness of the textbook material. Connect the concepts and details in the textbook to real-world scenarios, practical applications, and possible careers in the future. Educate students about the way the textbook could improve their success and general education.
2) Teach students effective methods of reading to promote engagement with the academic activity. This involves methods like scanning the chapter, highlighting key sections, taking notes, summarizing significant concepts, and talking with colleagues regarding the subject matter. Provide advice about how to effectively utilize the textbook's navigating and information, extracting capabilities effectively.
3) Ensure that the information provided in the textbook correlates to the examinations, tests, and projects. Students are more likely to devote close attention to the topic when they can see an obvious connection between the material they read and their academic performance. Include tasks and assignments that ask students to demonstrate their ability to understand the information contained in the textbook.
4) Promote group discussions and collaborative learning where students can contribute understanding, explore hard textbook topics. Conversations between students can improve comprehension, develop critical thinking, and encourage more in-depth involvement with the subject matter.
5) Add to the textbook additional resources that will help in student learning. This could come in the form of lecture notes, additionally readings, websites, lecture videos, or interactive multimedia material. Multiple avenues for getting for knowledge may meet varied methods of learning and improve student comprehension.

5.2. Limitations and implications for further research

The research has multiple limitations; first and foremost, the results were not usual for every student in the college since the sample size of 120 students from CSU was quite smaller. Consequently, consideration should be used when extending the results to other universities or areas of education. Additionally, there was little potential to acquire qualitative insights because the study only used quantitative data that was gathered using a survey questionnaire. The use of qualitative techniques, such as focus groups or interviews, would have permitted a more thorough investigation of the students' opinions and experiences with textbooks. Given such limitations, it is important to consider how they can affect the external validity and completeness of the results of the research. Additional research that includes bigger and more variable sample sizes, includes qualitative data, and goes beyond a single organization could be able to provide researchers with a deeper understanding of the role and significance of textbooks in education.

Ethics approval
The Chicago State University (CSU) Human Research Ethics Committee approved the study (Protocol 002-01-21). Informed consent was obtained from all participants in this study.

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Abbreviations
CSU Chicago State University
OER Open Educational Resources
PDF Portable Document Format

Conflict of interest statement
The authors declare no conflicts of interest.

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